Railway Mechanical Engineer

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The Index for 1920

As a means of conserving paper during the war, only a limited number of copies of the index for the *Railway Mechanical Engineer* were published and these were distributed to subscribers upon request. This arrangement was apparently satisfactory to our readers and, as the paper shortage still exists, the same practice will be followed this year. Subscribers who wish to obtain a copy of the index should write to the Circulation Department of the *Railway Mechanical Engineer* so that the request will be received before January 1, 1921.

Locomotive "Terminal-ogy"

While the locomotive terminal is distinctly an operating factor and terminal management is truly an operation function, it is the mechanical equipment of the terminal that determines its capacity not only to maintain locomotives in good condition but to expedite their movement. There is a surprising variety of design in all terminal construction. It would be hard to find two ash pits alike on a single railroad and while there is still a preponderance of old inclined coal trestles in operation, modern coaling stations exhibit an infinite variety of design. Very few railroads have any well defined standards relating to enginehouse construction and equipment and these show such a wide divergence in character and completeness that it would be well to ask whether mechanical engineers could not profitably devote more time to a study of the various locomotive terminal facilities, not only on their own but on neighboring railroads, to determine what types are most effective and economical in operation. There is little question but that locomotive terminal facilities will undergo greater relative development in the next ten years than any other mechanical facility and it is important that mechanical engineers should be prepared to advise the railroads wisely in regard to the design and equipment of these facilities. It is a mistake to entrust the design of a new terminal wholly to the engineering department. It should be borne in mind that these facilities are to be used continuously by the mechanical department, and every terminal project should represent the best judgment of both mechanical and civil engineers. Moreover, in view of the true function of a locomotive terminal, the transportation department might well be consulted in regard to terminal improvements. What every railroad should do is to outline a broad, comprehensive plan that will take into consideration terminal needs for years to come. A committee representing the mechanical, engineering and transportation departments should be selected to study the problem and outline a plan to which all future construction should adhere.

What Every Mechanical Engineer Should Know

There is one activity of the government that should be better understood and more fully appreciated, particularly by mechanical engineers. This is the United States Patent office. Often regarded as an institution for protecting certain individual interests, it is in reality the greatest single factor in the mechanical development of the age. The railroads are particularly indebted to our patent laws for the rapid development of the many specialties that have made modern railroading possible. George Westinghouse would not have devoted so important a part of his career to the development of the air brake if he had not been assured of a proprietary interest in this invention by virtue of the patent law, nor could a mechanical engineer today afford to spend any considerable time or money in the development of an invention if he were not certain that his title to this invention would be clearly established. Very few industries could afford to devote years in perfecting a certain device if the improved device could

later be marketed or used by anyone without the payment of a royalty. The telephone, the electric light and practically every other mechanical achievement owe their development in part to our system of patent protection. It is not too much to say that our industrial development is entirely dependent upon the patent office. Any mechanical engineer who has recently been in touch with the United States Patent office knows that this branch of the government is presented with more work than it can handle expeditiously and that as the salaries of its technical experts have been maintained at a pre-war standard its work is handicapped by the loss of many good men who have been attracted to outside positions. It may require months to obtain decisive action on an important invention because the particular division to which the application is assigned has hundreds of applications ahead of it waiting to be acted upon. It is not generally known, however, that the fees attached to these applications considerably exceed the running expenses of the patent office and that a surplus is annually turned over to the Secretary of the Interior to be applied against the deficit incurred by some other department of the government. Not only the railroads and the industries that supply the railroads, but every mechanical engineer should individually feel concerned over the welfare of the patent office and should exert whatever influence he can bring to bear towards putting this important governmental activity upon the most efficient basis.

"The Monarch of the Rails"

So far from arriving at any definite conclusions concerning the relative merits of steam and electric traction, the recent discussion at a joint meeting of the Electrical and Mechanical Engineering Societies had the effect of confusing many of those who came to the meeting with fairly definite notions as to the characteristics of both modes of traction. Out of the host of generalities and maze of details presented at this meeting and abstracted elsewhere in this issue, a few really important conclusions as to the relative merits of steam and electric locomotives may be garnered. If one will disregard the comparisons attempted between modern electric locomotives and out-of-date steam locomotives or between electric locomotives operating under hypothetical conditions and imaginary steam locomotives operating under assumed conditions, he may find in parts of the discussion a statement of facts that shed real light on the ability of the electric locomotive to save coal. A representative of the N. Y. N. H. & H. stated that the coal consumption on the electrified section of that railroad over an extended period had averaged 9.3 lb. per car miles in passenger service and 84 lb. per 1,000 ton-miles in freight service. Even if Mr. Ralston had not stated that the coal consumption on steam locomotives over the same section of the line averaged 19.3 lb. per car-mile and 199 lb. per 1,000 ton-miles it would be evident to anyone familiar with steam locomotive practice that electric locomotives are actually hauling both freight and passenger trains in main line service with very much less coal than would be possible with the most modern steam locomotive operation. If representatives of the electrical manufacturers would confine their arguments to a simple statement of the actual coal consumption over an extended period upon the basis of ton and car-miles hauled, or where water power is utilized to convert this into an equivalent coal consumption they would have less difficulty in proving their contention that the electric locomotive can save coal. When it comes to a question of maintenance, the advantage of the electric locomotive is not quite so clear and the exponents of electrification are prone to overlook power plant maintenance as a factor to be reckoned with in connection with the electric locomotive. Broadly speaking, the electric locomotive is not "the monarch of the rails" as it has been described, but always a servant at the beck and call of the central power station whereas the steam locomotive is truly a self-contained unit and will always occupy a field by virtue of this fact that can never be invaded by its electrical rival. For an unbiased exposition of clear thinking on the entire subject we commend our readers to that part of the discussion contributed by W. L. Bean and A. W. Gibbs.

Fusion Welding An Art By Itself

The so-called fusion welding processes have received a remarkably rapid development and extension in the comparatively few years since their introduction as regular features of railway equipment maintenance. As a natural consequence of this rapid development a reaction has become evident in the minds of some of those who have to do with the results as applied to locomotive and car parts. This is not necessarily serious but it is a warning that the future extension of the art must be based on a far more thorough study of the conditions to be met by the welds, of welding methods and practices, and of the metallurgical aspects of welding, than has been devoted to the subject in the past. Fusion welding has passed through its pioneer development and must now be reduced to a science.

The greatest obstacles in the way of stabilization and sound future extension of these welding processes in the railroad shops are the provisions of the so-called National Agreement, which makes them mere adjuncts of the other crafts. Under this agreement welding must be performed by machinists, boiler makers, blacksmiths, tinsmiths and carmen, and by its provision, the qualifications which control in the selection of welders is seniority of employment as a craftsman in one of the other trades. Under these conditions it is manifestly impossible to maintain the degree of permanency in the welding forces essential to the development of highly skilled and experienced operators; the kind of work assignable to each welder limits his experience and outlook and the supervision is divided among the regular shop foremen, to none of whom welding is a primary interest.

The short time in which one may acquire a sufficient degree of skill in the manipulation of the torch or electrode so that he may "get by" is possibly one of the most potent factors in the rapidity with which the processes have come into general use. But it also constitutes one of the greatest dangers to sound future development. One of the best ways of avoiding this danger is to organize fusion welding work as a trade by itself, for training in which men may be selected who have the proper temperament and whose purpose is to make welding a permanent vocation. Not only will this lead to the develoment of more skilled operators, who in time will supplement their skill with more or less knowledge of the metallurgical questions involved, but better supervision will become possible because of the concentration of the work in a department by itself and because the craft training of the welders will provide the material from which competent supervisors may be selected. The possibilities for economy in the railroad shop offered by these processes are too great to permit the strangling of their future development by the permanent establishment of conditions under which they must now be applied.

Don't Neglect Your Pyrometers

One of the most important factors in insuring good tool service is a suitable complement of heat treating furnaces, so equipped that close regulation and accurate measurement of temperature is possible. One of the essential items of a tool treating installation is the pyrometer. Without this instrument the color method of judging temperatures must be depended upon and it has been demonstrated that the most skilled heat

treater is unable, under all conditions, to determine temperatures within limits of variation narrow enough to be permissible if uniform results are to be obtained. These facts have already been recognized by mechanical department officers of many railroads and where the conviction has been backed up by the installation of the equipment, gratifying results have generally been obtained. But in some cases there has been a tendency to assume that, once provided, such equipment needs no further attention. Where such an attitude exists the results are very likely to prove disappointing.

The pyrometer is a delicate instrument and care is required in its installation and its readings should be checked frequently if accuracy is to be insured. Otherwise the effect of its use may be even worse than if full dependence had been placed on the eye of the tool treater. Where the best results have been obtained it will generally be found that some means has been provided for periodically checking and calibrating the pyrometers. Some pyrometer manufacturers advocate the checking of these instruments at intervals not exceeding three months, not necessarily because the instruments are expected to require adjustment at such frequent intervals but as an insurance against the loss which might follow should an instrument for any reason get seriously out of adjustment. The periodical checking of these instruments offers no great difficulty and there are available at least three means from which to choose. Under most conditions probably the most satisfactory plan is to purchase a standard instrument which should be used only for comparisons with the service instruments and for special investigations in the test department. These instruments may be calibrated, say once a year, by sending them to the Bureau of Standards at Washington or to a commercial testing laboratory. Or, where the commercial testing laboratory is readily accessible it may be entirely practicable to send the service instruments themselves for periodical calibration. The pyrometer manufacturers in some cases are developing service organizations for the purpose of checking instruments of their own make without removing them from the shops where they are in use, a regular service which may be obtained for a nominal fee.

Whatever means may prove must practicable, it is important that the periodical calibration of pyrometers be provided for and insisted on if the maximum return on the investment is to be obtained from modern heat treating equipment.

What Do You Think?

The editors of the Railway Mechanical Engineer aim to present in each issue a sufficient variety of material to insure that every subscriber will find a number of articles that are of direct interest and value to him. Is the range of subjects covered in this issue great enough to give you the information that you are looking for? Let us look it over and see.

One of the principal articles describes a series of tests of the locomotive booster. No device that has been brought out in recent years has created as much interest as this. Here is the story of what it does in actual service.

A prominent electrical engineer has recently proposed the electrification of all the railroads north of Washington, D. C., and east of the Allegheny mountains. When such proposals are being made, railroad men will surely want to have a clear idea of what the change to electric operation could be expected to accomplish. The papers on the Relative Merits of Steam and Electric Traction will help in forming an opinion on this important subject.

The locomotive terminal is becoming more important as locomotives grow larger and more difficult to maintain. The article on the Locomotive Terminal as an Operating Factor was written with this thought in mind and is intended to give constructive suggestions for getting more service from the motive power.

The principal feature in the Car Department section is the report of the C. I. C. I. & C. F. A. convention. The papers and discussions show what the car men who are actually on the firing line are thinking and doing. Whether you are interested in yard or shop work, passenger or freight this will give you some new ideas.

Don't you suppose that your welders would do better work if their jobs were tested occasionally? The author of the article on testing welds is a practical man and a vise and a hammer are the only tools needed to make the tests he recommends.

Every shop and roundhouse man knows how much trouble is caused by cut flanges. The new method of curing this old trouble which was developed on the New York Central at West Albany is described in this issue.

These are only a few of the high spots; the rest of the articles are just as helpful in their special fields.

When New Year's Day arrives the editors will all resolve to make the Railway Mechanical Engineer better than ever next year. When you finish reading this issue we would like to have you sit down and write the editors telling them what you liked and what you did not like in the recent issues, and what they can do in the coming year to make, not their paper but YOUR paper, more interesting and valuable.

Poor Equipment and Operating Costs

Much has been said about the need for improvement in car conditions and everyone having to do with the maintenance of rolling stock is endeavoring to reduce the percentage of bad order cars. Unfortunately, however, the number of cars reported in bad order is a very poor measure of car conditions and their effect on operating costs. Only too frequently a campaign to reduce the percentage of bad order cars, instead of actually improving conditions, leads to a lowering of maintenance standards which has an adverse effect on the cost of operation. Many cars of weak construction are still in service and must be perpetuated for several years until enough new equipment can be financed and built to make up for the accumulated shortage of the war period. In laying out programs of re-enforcement there is a tendency to consider only the investment value of the equipment and many of the older cars are being permitted to remain in service until they are automatically retired by being broken up in service. Failures of such equipment cause innumerable delays to train movement with a heavy quota of crew overtime which must be paid for at time and one-half time. Their use leads to the destruction of freight, which must be paid for by the railroads, and adds a serious element of danger to train operation. The buckling of a car of weak construction in a heavy freight train, is almost sure to result in scattering equipment and freight alike all over the right of way. Such accidents are common and when their cost is added to the cost of overtime from train delays at terminals and on the road, caused by the necessity of switching out defective equipment, a field for economy will be found which justifies the extension of betterment programs well beyond the point fixed by considerations of capital expenditure, theoretical earning capacity and maintenance costs.

THE PRICE OF GOVERNMENT OWNERSHIP.—Disclosures in the United States Shipping Board investigation furnish convincing grounds for argument against government ownership and operation. While the investigation has not yet proceeded far enough to determine whether any blame for unnecessary expenditures rests with those in charge of the Board's affairs, enough has been revealed to show that governmental ownership and operation is a prohibitively costly luxury.—*Virginian Pilot and Norfolk Landmark.*

NEW BOOKS

Proceedings of the American Railway Tool Foremen's Association for 1919, 274 pages including advertising, 6 in. by 9 in., bound in cloth. Published by the Association, R. D. Fletcher, secretary-treasurer, 1145 East Marquette road, Chicago.

This book contains a complete transcript of the proceedings of the 1919 convention of the American Railway Tool Foremen's Association. This convention was the first to be held since 1916 and, despite unfavorable conditions existing at the time it was held, a number of very instructive papers were presented and thoroughly discussed. The value of the year book, however, does not lie wholly in its presentation of the proceedings of the convention, as it contains a number of well illustrated papers on jigs and special devices and tools which were received too late to be presented before the association during the convention. Many of these devices contain valuable suggestions for shop foremen other than tool foremen.

Data Book for Engineers. Published by the Locomotive Superheater Company, 30 Church street, New York. 79 pages, 4½ in. by 8 in., bound in flexible leather covers.

The most noticeable feature of this book is the ease and facility with which any required data or tables may be referred to. The book contains the data most frequently desired by steam or power plant operators with special reference to those in charge of superheated steam boilers. The first few pages of the book summarize the factors affecting the advisability of installing superheater units in saturated steam boilers. Fuel cost, engine performance, boiler maintenance, labor charges, steam-line losses and the relative first cost are among the factors considered. Tables showing the factors of evaporation, grate area per horsepower and the dimensions of various types of boilers are given; also additional tables showing the size of chimneys per boiler horse power, fan dimensions and dimensions of standard boiler tubes. Much additional instruction in the way of determining the flow of steam in pipes, calculating boiler horse power, speed of pulleys, etc., is given. For reference in solving problems, saturated and superheated steam tables are shown in the back of the book. All tables and information are conveniently arranged and can be readily located by means of a carefully arranged index.

Proceedings of the Master Boiler Makers' Association. Edited by Harry D. Vought, secretary of the association, 95 Liberty street, New York. 149 pages, 6 in. by 9 in., bound in cloth.

This book contains the official proceedings of the twelfth annual convention of the Master Boiler Makers' Association held at Hotel Curtis, Minneapolis, Minn., on May 25 to 28, inclusive, 1920. As customary, the first few pages of the book contain a list of officers for the year 1920-1921, subjects and committees for the 1921 convention, and a list of the members and guests who registered at the convention. The opening exercises and addresses are reported in full, together with reports of the secretary, Harry D. Vought, and treasurer, W. H. Laughridge. Committee reports, together with the complete discussions, are given in the book, including the report of the Committee on the Best Type of Washout Plug and four other important topics, as previously announced for consideration at the 1920 convention. In addition, there is included the address of Professor Alfred S. Kinsey, of Stevens Institute of Technology, and a paper on Electric Welding by Charles L. Hempel. The report of the Committee on Law and Resolutions is given and the latter part of the book is devoted to publication of the constitution and by-laws, together with the membership list and a list of the Women's Auxiliary.

Bituminous Coal Storage Practice. By H. H. Stoek, C. W. Hippard and W. D. Langtry. Bulletin No. 116, Engineering Experiment Station, University of Illinois, Urbana, Ill., 150 pages, 6 in. by 9 in., bound in paper.

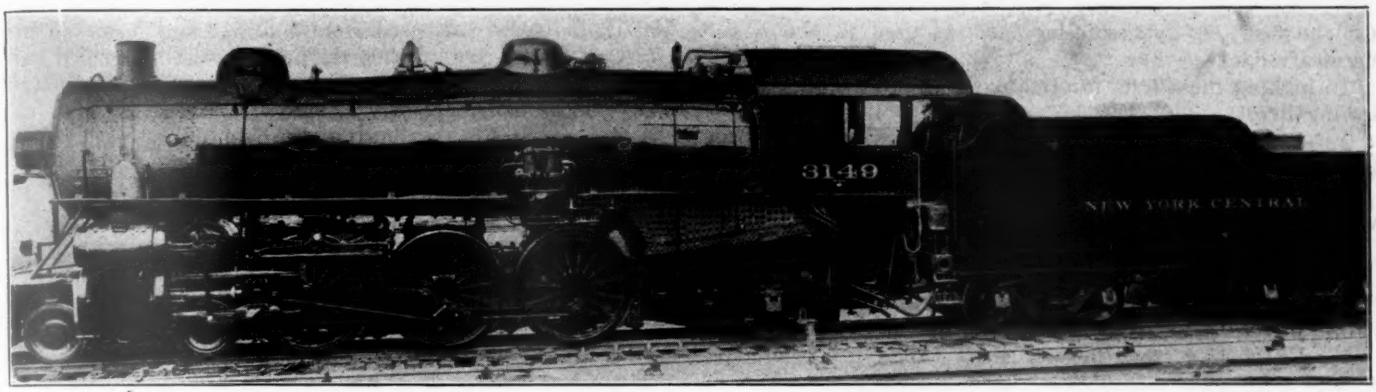
The growing inability to maintain a steady flow of coal from the mine to the consumer to take care of the fuel demands of the country currently, especially during the winter season, has attracted wide interest to the problem of storing large quantities of coal near the point of consumption. One of the most serious handicaps to the storage of bituminous coal is the constant danger of spontaneous combustion. A study of the causes of spontaneous combustion and methods of prevention has been undertaken by the Engineering Experiment Station of the University of Illinois and has been in progress for several years. Considerable information on the subject was included in Circular No. 6, on "Storage of Bituminous Coal," issued in 1918, and Bulletin No. 116, contains much additional information which has been obtained by a study of the circumstances surrounding a considerable number of fires in stored coal, as well as of methods of inspecting storage piles which have been followed with success in the prevention of fires. The results of these studies are given in detail and the bulletin is invaluable to any large user of coal who now has storage piles or contemplates the storage of coal in quantity.

The Making, Shaping and Treating of Steel, by J. M. Camp and C. B. Francis, Bureau of Instruction, Carnegie Steel Co. 600 pages, illustrated, 5 in. by 8 in. Bound in cloth. Published by J. M. Camp, Carnegie building, Pittsburgh, Pa.

The scope included by the title of this work naturally suggests a voluminous treatise. However, the authors have covered the comprehensive subject very well in a book of 600 pages by eliminating all non-essential matter. The book is frankly a description of the steel industry as it exists; it is not written from the viewpoint of the steel expert and comparatively little is said about the future development of the industry. For that reason, anyone thoroughly versed in the manufacture of steel might find little that is new in the book. For the railroad officer who desires a thorough knowledge of the steel industry and its most important products, the book is extremely valuable. Designed as a course of instruction for salesmen, this work necessarily includes practically all the information required by those who buy or use steel.

The book is strictly non-technical and opens with a discussion of the fundamentals of physics and chemistry as applied to steel making. The entire process from the ore to the finished product is then outlined in a systematic manner. The various ores, refractories, fuels, fluxes and slags are discussed and the manufacture of coke by the beehive and by-product processes is described. In the discussion of the making of pig iron, the construction and operation of the blast furnace and the chemistry of the process are covered. The Bessemer and open-hearth processes are treated in a similar manner, a short history of their development being included. Another chapter is devoted to the manufacture of steel in electric furnaces, which is followed by a description of the duplex and triplex processes. The section on the shaping of steel discusses chemical properties, describes the rolling mill and covers in some detail the rolling of blooms, billets, plates, rails and rail joints, the strip and merchant mill products, rolled steel wheels and axles.

The third part of the work treats of the constitution, heat treatment and composition of steel. The solution theory of steel is explained and the theory and practice of heat treatment are discussed with this as a basis. The concluding chapters are devoted to the effect of the common elements on the mechanical properties of carbon steel and a short description of the more usual types of alloy steel.



New York Central Pacific Type Equipped with Locomotive Booster

TESTS OF A PACIFIC TYPE BOOSTER LOCOMOTIVE*

Additional Tractive Effort of Booster Increases Tonnage Rating for Division on New York Central

"IDLE weight and spare steam harnessed in a simple way to do useful work at a critical time." This, in a few words, describes the locomotive booster which causes the trailing wheels to act as driving wheels in starting the train and to get it over the hard pulls on the road. For the past ten years or more locomotive designers have been striving for increased drawbar pull. Their efforts have increased the load per pair of drivers and the number of driving wheels until today the load limit that track and bridge structures will bear has been closely approached. In starting and foot of a momentum grade necessitates cutting loose and running for water. Stopping for signal or other cause on a hill may necessitate backing down to get started again. Loss of time in starting disrupts train schedules and often results in loss of train rights with consequent overtime, as well as increased operating costs.

Locomotives as ordinarily built today are hauling around a large percentage of weight that is useless except to permit of making the boiler larger. To permit train loading that would utilize a greater percentage of the available draw-

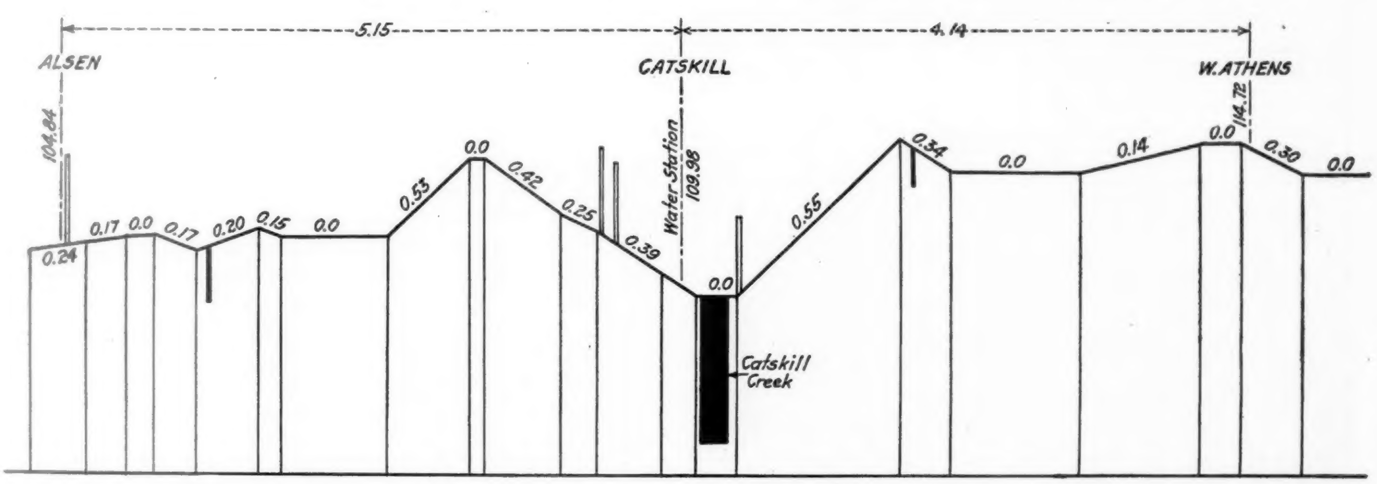


Fig. 1—Profile of West Shore Division at Catskill

at slow speeds every locomotive built has greater boiler capacity than it can utilize. While, of course, increased wheel loads and larger units mean greater tractive effort, the limiting factor, the ruling grade, determines the load a locomotive can haul over the division. To obtain maximum practical effectiveness from the locomotive and offset the tonnage limit imposed by the ruling grade several methods are in use. One is to station pushers at the foot of the grades to help the train over the hill; another is to make up the train, wherever possible, so as to drop several cars at some way point. Both are expensive and unsatisfactory.

Loading locomotives to the limit involves several other perplexing operating problems. A water plug located at the bar pull over the entire division and yet have sufficient power available for the critical points where extra power is needed led to the invention and development of the locomotive booster.

For approximately two years Engine 3149 equipped with the booster has been in operation on the New York Central. To determine the operating advantages of the booster, a series of tests was conducted on the River division between Ravena and Weehawken. This division is 130 miles long with a ruling grade of one per cent at Bogota going west and 0.46 per cent at Haverstraw going east. The locomotive used in these tests, 3149, is of the Pacific type with a load on drivers of 184,000 lb., steam pressure 200 lb. and a tractive effort of 40,000 lb. It was exhibited at the Atlantic City convention and has been in continuous road service since that time; no special preparations were made

*A description of the locomotive booster was published in the *Railway Mechanical Engineer* of May, 1920, page 265.

for the test. A dynamometer car was used to obtain the necessary data.

In making these tests information was wanted on the following items:

1. Practical increase in tonnage that could be hauled over the division because of the booster.
2. Effect of the booster on train operation over the division.
3. Maximum drawbar pull with the booster in action.
4. Maximum drawbar pull without the booster.
5. Time saved over the division because of the booster.
6. Increased train acceleration by use of the booster.
7. Effect of a crew, inexperienced with the booster, operating a locomotive equipped with a booster.

Test Results Going East

The first test was made going east from Ravena to Weehawken. Without the booster, Engine 3149 is rated from Ravena with 2,600 tons and runs to Newburgh where the tonnage is reduced to 2,100 tons, a reduction of 19.2 per cent. In making this test it was decided to endeavor to bring 2,582 tons through to Weehawken. This not only involved getting over the ruling grade at Haverstraw, but also introduced other interesting and important operating problems.

At Catskill the water plug is located at the bottom of two grades. It is the usual practice to leave the train at the top of the grade west of the water plug, run two miles for water, back up to the train and make a run down-grade to get sufficient momentum to carry over the up-grade. The profile of the road at this point (Fig. 1) shows a down-grade of

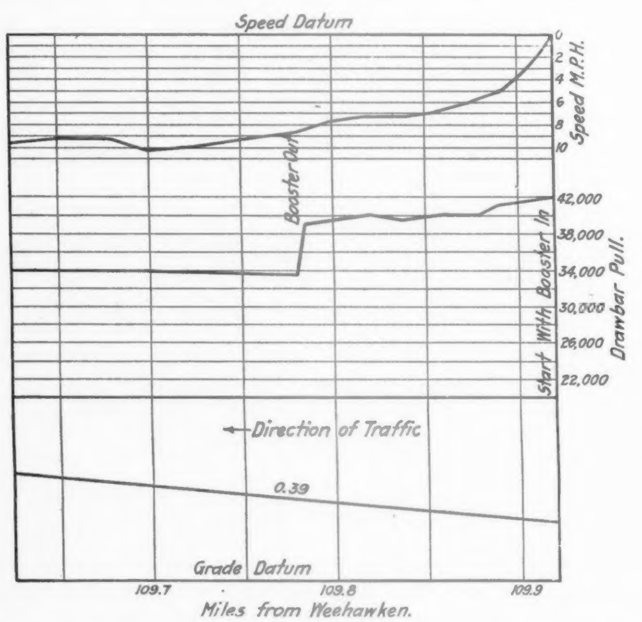


Fig. 2—Dynamometer Record of Booster Locomotive on Catskill Grade

0.55 per cent and an up-grade averaging 0.375 per cent. Running for water in this way consumes 20 to 30 minutes' time in good weather. When the weather is bad with sleet and snow 30 minutes' time is usually lost in pumping up the train line alone before the train can be started after coupling up, thus more than doubling the time lost.

In the test run the practice referred to was not followed. Engine 3149 hauled the train to the water plug intact, took water and started up the grade with the full train with the booster in operation. As shown by the dynamometer record (Fig. 2) the locomotive, with the booster in operation, accelerated to five miles per hour very quickly, the drawbar pull showing 41,067 lb. at this point and in a distance of 580 ft. the speed increased from 5 to 8½ m.p.h., or an increase of 70 per cent. When the booster was disengaged and the locomotive took the load entirely, the drawbar pull showed 33,497 lb., a difference of 7,570 lb.

Reference to Fig. 1 showing the road profile and Fig. 2

RULING TONNAGE FOR WEST SHORE DIVISION

Distance				
Weehawken 0 miles	Cornwall 52 miles	Newburgh 57 miles	Kingston 88 miles	Ravena 129 miles
TONNAGE GOING EAST WITHOUT BOOSTER				
....	....	2,100 tons	....	2,600 tons
TONNAGE GOING EAST WITH BOOSTER				
2,582 tons	....	....	....	2,582 tons
TONNAGE GOING WEST WITHOUT BOOSTER				
1,800 tons	....	2,100 tons	2,600 tons	....
TONNAGE GOING WEST WITH BOOSTER				
2,015 tons	2,577 tons	....	2,745 tons	....

showing the dynamometer record clearly indicate the part the booster played in making possible the starting of the

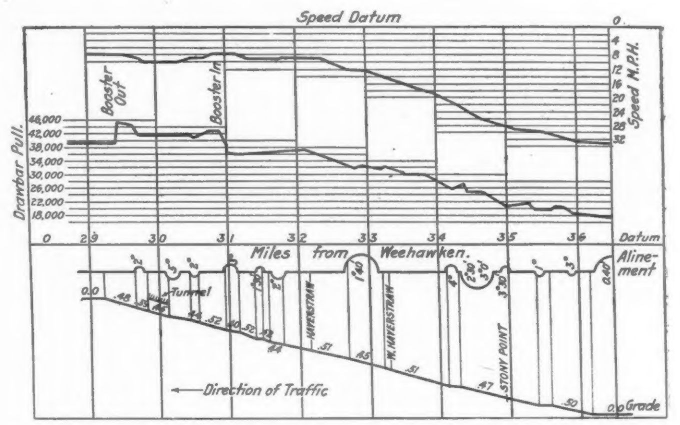


Fig. 3—Performance of Booster Locomotive With 22.6 Per Cent Excess Tonnage on Haverstraw Grade

train and getting up to speed on the grade; without the booster this performance would have been impossible.

At this point an important time saving operating situation developed. Because of the time saved at Catskill, West Point was reached just three minutes before an express was due. The express was followed to Weehawken, whereas usually two or three local passenger trains are allowed to go ahead. At times this adds another 30 minutes' delay in addition to the time lost at Catskill. After leaving Catskill the booster was used for starting whenever the train was stopped for signals or other reasons, each start showing rapid acceleration.

The ruling grade on this division is known as the Haverstraw grade (Fig. 3). It is over six miles long and the average gradient is about 0.46 per cent. This grade was approached at a speed of 33 m.p.h. with the booster idle and continuing up-grade the speed dropped as follows:

At the end of the first mile, 28½ m.p.h.
At the end of the second mile, 19 m.p.h.
At the end of the third mile, 12 m.p.h.
At the end of the fourth mile, 8 m.p.h.

At the fifth mile the speed was 7½ m.p.h. and falling rapidly. The drawbar pull was 36,441 lb. Without the assistance of the booster the train would have stalled.

At this point the booster was cut in on a 0.52 per cent grade, and in 432 ft. the speed reached eight miles per hour and the drawbar pull 42,900 lb., an increase of 6,459 lb. drawbar pull or 17.7 per cent because of the booster. In the first ¾ mile, after the booster was working, the speed reached 10 m.p.h. This shows an acceleration, because of the booster, in three-quarters of a mile of 33⅓ per cent with

a train tonnage 22.9 per cent above normal. In taking this train over the ruling grade the booster was used for about 1⅝ miles and just before being disengaged a drawbar pull of 45,080 lb. was recorded on the dynamometer car.

The train arrived at Weehawken with the same tonnage with which it started from Ravena. This was the first time this tonnage had ever been hauled over the entire division

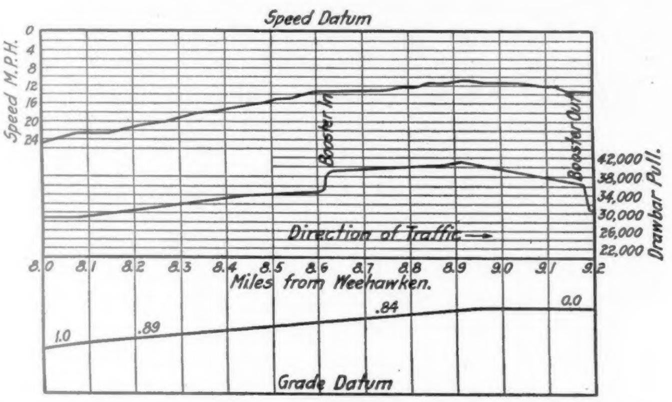


Fig. 4—Drawbar Pull and Speed Record Ascending Bogota Grade

by this type of locomotive. In addition no difficulty was experienced and the locomotive was handled by a crew not regularly assigned to the locomotive. Since this test was made the crew regularly operating this locomotive has hauled 2,618 tons over the division, an increase of 24.6 per cent over the regular tonnage.

Test Results Going West

By referring to the tabulated statement it will be noted that the tonnage rating of this locomotive without the booster

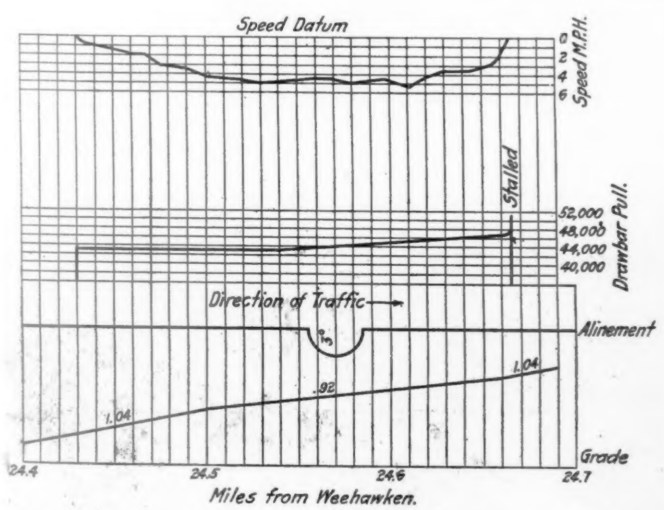


Fig. 5—Stalling Test to Determine Maximum Drawbar Pull With the Booster

is 1,800 tons to Newburgh, at which point it is increased to 2,100 tons to Kingston, where it is again increased to 2,600 tons to Ravena. Use of the booster permitted increasing the tonnage to 2,015 out of Weehawken, increasing it to 2,577 at Cornwall and again increasing it to 2,745 tons at Kingston, which tonnage was hauled to Ravena.

The ruling grade going west on this division begins 7⅓ miles from Weehawken at Bogota. It is a one per cent grade approximately 1¾ miles long. The dynamometer record was started at a point eight miles from Hohokus, where the speed was 25 m.p.h., and about two-thirds the way up the speed had dropped to 13 m.p.h. At this point the booster was cut in. As shown in Fig. 4 the drawbar pull immediately increased from 34,228 lb. to 38,793 lb., an increase of 4,565 lb.

At West Nyack a test was made to determine the combined power of the locomotive and the booster. The grade at this point is 1.04 per cent. The train was brought to a standstill and a start made by taking slack. As shown by the dynamometer car record (Fig. 5) the train proceeded .235 of a mile, where it stalled, and the maximum drawbar pull at zero speed registered 51,138 lb. The boiler pressure re-

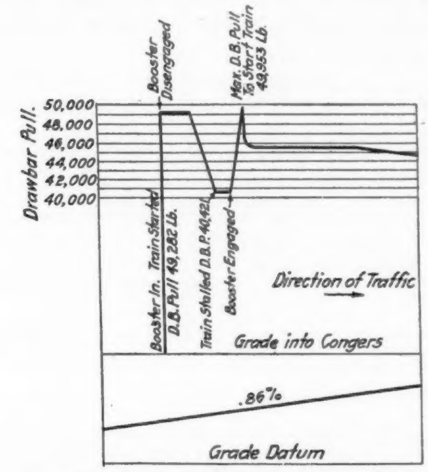
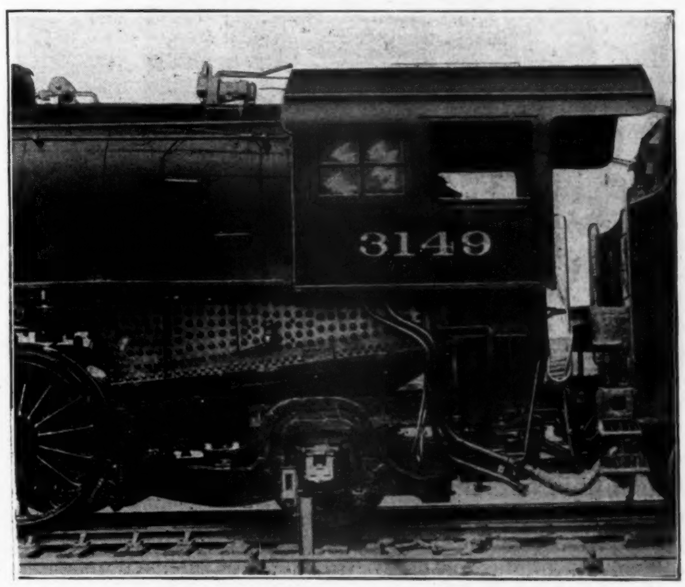


Fig. 6—Stalling Test to Determine Maximum Drawbar Pull Without the Booster

mained constant; the throttle was wide open and the reverse lever in the corner.

To determine the maximum drawbar pull of the locomotive without the booster a test was made on an 0.86 per cent grade into Congers, the tonnage at this point being 1,958 tons, one car having been set off on account of hot boxes. With the booster working, the train was brought entirely on the grade, the booster then cut out, and the engine proceeding until



A Close View of the Trailer Truck With the Booster

stalled. As shown by the dynamometer car record (Fig. 6) the drawbar pull registered 40,421 lb. at zero speed. To get the train moving again the booster was engaged and the maximum drawbar pull registered 49,953 lb., showing an increase of 9,532 lb., or the additional drawbar pull which the booster exerted.

At Cornwall the tonnage was increased to 2,577 tons, the

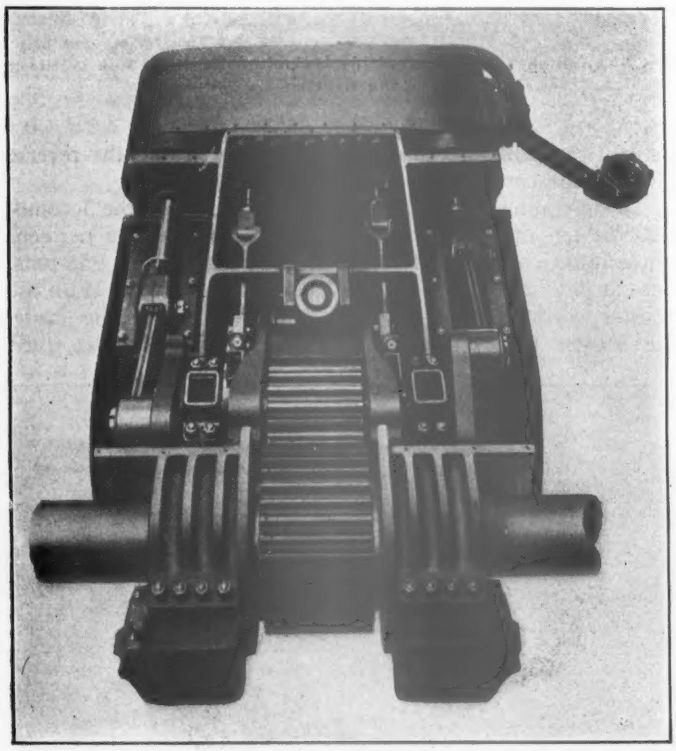
usual tonnage from this point to Newburgh being 1,800 tons. At West Park, on a .52 per cent grade, it was found necessary to use the booster again as the speed had dropped to 12 m.p.h. Upon arrival at Kingston the train was increased to 2,745 tons, which is 145 tons in excess of the regular rating of 2,600 tons, and the train continued to Ravena successfully handling this tonnage.

One of the important features of the booster emphasized by these tests was the rapid acceleration, which is accomplished at practically no increase in weight, as the booster weighs less than 4,000 lb. The following tabulation shows clearly the reason for this:

Maximum drawbar pull of locomotive	40,421 lb.
Drawbar pull of locomotive necessary to move train on given grade	36,441 lb.
Difference (force available for acceleration)	3,980 lb.
Maximum drawbar pull of locomotive with booster in operation	49,618 lb.
Less drawbar pull necessary to move train	36,441 lb.
Reserve for acceleration with booster is increased to	13,177 lb.
Deducting force available for acceleration without the booster	3,980 lb.
Increased force available for acceleration on the same locomotive with the booster operating	9,197 lb.

Hence 9,197/3,980 equals 231 per cent increase in force available for acceleration purposes.

On freight trains rapid acceleration is important, as it enables a quick get-away and the increase in available starting power means a smooth, even start.



Driving Mechanism of the Booster

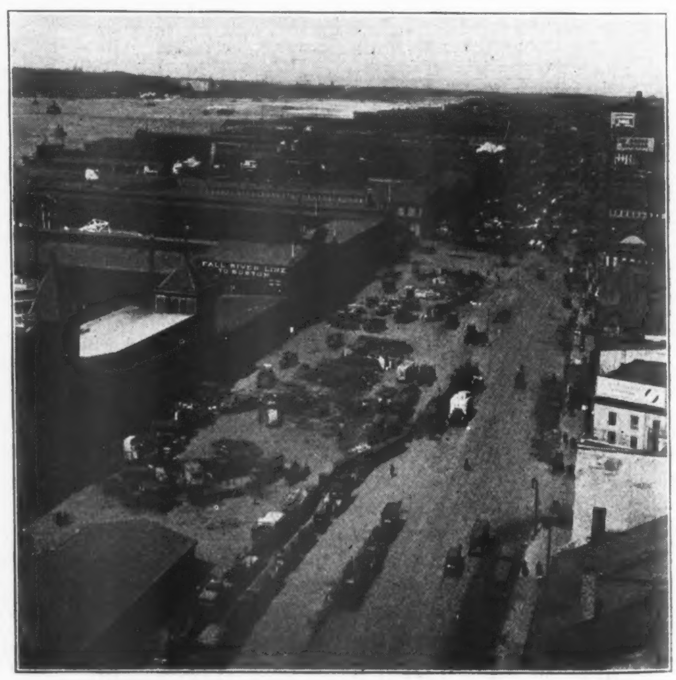
Quick acceleration often saves sufficient time to permit a freight train to continue on its run when otherwise it might necessarily have to take a siding to permit other trains to pass. Moreover, the additional capacity which the booster contributes to the locomotive in starting avoids damage to rolling stock by avoiding the need of taking slack.

On passenger trains it means saving time in starting from station or other stops. A few minutes saved at each stop with a heavy train helps maintain operating schedules. The smooth, easy start also adds to the comfort of the traveling public.

Conclusions

From the results of these tests the following conclusions were drawn:

1. The booster makes possible increasing the tonnage that a locomotive can haul.
2. It provides quick acceleration that helps maintain schedules more easily and reduces the time over the division. In several instances under observation the time consumed in getting freight trains out of terminals and yards was reduced 50 per cent.
3. It eliminates the need for taking slack in starting.
4. It reduces tire and rail wear as slipping of drivers is avoided.
5. Because of its smooth, steady pull at starting it reduces wear and tear on equipment and eliminates breaks-in-two.
6. It increases the average speed over grades and eliminates stalling.
7. The booster power is always instantly available at speeds below 12 m.p.h.
8. It helps relieve traffic congestion, increasing the maximum ton-miles over the division.
9. No extra coal is consumed because of the booster, and fuel economy should result because the time required over the division is reduced.
10. The booster is automatic in operation and control and adds no extra duties to the engine crew.
11. It gives the effective increase in starting drawbar pull that an additional pair of drivers would give, but avoids hauling around 50,000 lb. or more weight that a larger locomotive would involve, weight that is useless a large percentage of the time and that present track and bridge structure will not carry.
12. The booster is in motion less than 10 per cent of the time. Its maintenance is negligible.
13. It avoids stalling where sudden weather changes while enroute would render impossible the hauling of normal tonnage.
14. It provides a reserve capacity that helps to even out the difference between an experienced and inexperienced crew.



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New York Harbor, Looking North Along West Street

Relative Merits of Steam and Electric Traction

Strong Points of Both Outlined at a Joint Meeting of Electrical and Mechanical Engineers

The advantages of steam and electric locomotives were discussed by their exponents at a joint meeting of the New York Section of the American Institute of Electrical Engineers, the Metropolitan Section of the Railroad Section of the American Society of Mechanical Engineers, held on October 22 in the Engineering Societies building, New York. One paper on steam locomotives and two papers on electric locomotives were presented and the papers were discussed by several railroad and railroad supply men.

The following are abstracts of these papers and the subsequent discussion:

ADVANTAGES OF ELECTRIC LOCOMOTIVES HAVE BEEN GREATLY OVERSTATED

BY JOHN E. MUHLFELD
Railway and Industrial Engineers, Inc.

In the protection and control of railroad net earnings, one of the most important factors is the kind of motive power to be used.

When discussing or recommending the further electrification of the whole or any part of the steam operated railroads in the United States, the most important item involved is a correct and complete statement of facts, comparing the most up-to-date steam with similar electric operations, after which immediately come the important factors of the necessary financing and legislation.

While there is much existing steam road trackage that can and should receive first consideration as regards electrification for the purpose of eliminating gases from underground terminals and tunnels and to give relief to terminal or line traffic congestion in the vicinity of large commercial and industrial centers, it would be financial suicide to electrify immediately adjacent connecting and intermediate mileage, particularly in view of the improvements that can be made in both existing and new steam locomotives in increasing general efficiency and economy in operation and maintenance.

Before the electric locomotive can be made permissible for general application the electrical engineer must reduce first costs; promote interchangeability; provide a motor which will efficiently, economically and flexibly cover a wide range of speeds and not break down or deteriorate from overloading and heating; reduce complication, wear and corrosion in transmission and contact line apparatus; and substantially reduce the current losses between the point of power production and the locomotive drawbar. Likewise the steam railway mechanical engineers, locomotive builders and specialty manufacturers, if they are to continue the steam locomotive in its present field of usefulness, must become more active in modernization and bring about improvements that will substantially increase its capacity and thermal efficiency by the use of higher steam pressures and superheat; compounding; more efficient methods of combustion; utilization of waste exhaust steam and products of combustion heat; better distribution and use of live steam; reduction of dynamic weights; greater percentage of adhesive to total weight and a lower factor of adhesion; and by a substantial reduction in standby losses.

In order to determine the relative advantages of modern steam and electric locomotives the following may be stated as important items for consideration:

Financing. Few if any existing steam roads can justify or stand the additional capital investment required per mile of road for electrification, except for short distances under very special conditions such as prevailed on the Norfolk & Western; where the ventilation and 1.5 per cent grade of ⅝ mile single track tunnel restricted the train movements to six miles per hour on a congested traffic section of the main line, and even then only providing the fixed charges and operating expenses are not too excessive.

Adaptability to Existing Trackage and Facilities. Foremost in favor of a continuation of the steam locomotive is its flexibility and adaptability to existing railroad trackage, terminal and operating facilities, and the relatively low first cost per unit of power developed for the movement of traffic. Being a self-contained mobile power plant, it is possible to quickly transfer needed or surplus power from one part of the line to another and to concentrate it when and where necessary, whereas with the electric locomotive this is impossible unless electrification extends over the entire property or the sources of power supply have almost prohibitive peak load capacity. Furthermore, the various systems of electrification do not make the interchanging of electric locomotives practicable without much non-productive first-cost, complication, and maintenance and operating expense.

Effectiveness in Increasing Track Capacity. Without a doubt electrification increases the capacity of a terminal. As already set forth, special line conditions may make electrification advisable for short distances, but results do not justify the frequent reference by electrical engineers to the weakness of steam locomotive haulage during the unprecedented cold weather in the winter of 1917-18. If electrification would have obviated the difficulty, why did the New Haven not operate at 100 per cent of its capacity, over its electrified zone at that time? If short of locomotives or motor cars the New York Central had plenty of surplus that was not in use and which could not be utilized outside of its electric zone where it was badly needed. The probable answer is lack of interchangeability, which is still one of the most discouraging operating factors involved in any electrification scheme. Although under the multiple unit system locomotive and train operation it is theoretically possible to provide unlimited sustained hauling capacity, at the head of the train, the tonnage to be handled without rear end or intermediate helpers is limited by the ability of the draft rigging on the cars to withstand the pull and shock, and this limitation can be readily met and exceeded in steam locomotive design and operation.

Train Speeds. The average freight car is in main line movement only about 10 per cent of its life, or 2 hr. and 24 min. out of each 24 hr. Therefore, increasing train speeds beyond established economic limits at the sacrifice of tonnage, and with an increase in fuel, track and equipment upkeep and danger of operation is not the solution of the freight traffic problem.

As the electric locomotive is a constant speed machine, whether going up or down grade, and is unable to utilize its rated capacity and effectiveness through the same range of speed and tractive power variations as the more flexible steam locomotive, the latter can therefore be more efficiently operated over the continually changing up and down grades, levels, curves and tangents traversed by the average freight train in this country. With respect to passenger train service, where speed is more of a factor, the steam locomotive performs equally satisfactorily.

Fuel Consumption. Great economy in fuel consumption and cost is the principal claim for electrification and recently electrical engineers have advanced the theory that it

would be possible to save at least two-thirds of the coal consumed by the existing steam locomotives and that the useful carrying capacity of existing trackage could be increased about 10 per cent by the elimination of company coal movement, if electric locomotives were substituted.

The basis for arriving at these comparative figures is so obviously ridiculous that they warrant comment only for the reason of the general publicity given.

However, accepting the assertion that the proposed electrification will produce 1,000 gross ton-miles for an average of 40 kilowatt hours, or 100 lb. of 12,000 B. t. u. coal, as stated and generally approved by electrical engineers, what can the modern steam locomotive do to justify its existence? The following results of dynamometer car tests made during 1918, may be of interest. The steam locomotives tested were of the ordinary superheated Mikado freight type. One locomotive was fitted for hand firing and burning coal on grates while another was equipped for burning powdered coal in suspension. The tests were made in tonnage freight service on the Santa Fe main line between Ft. Madison, Iowa, and Marceline, Mo. (the profile consisting of .8 per cent ruling grades), a distance of 112.7 miles, during March and April, 1918.

Item	Powdered coal locomotive	Hand fired locomotive
1—Total trips run (112.7 miles each)	14	10
2—Total miles run	1,578	1,127
3—Average running time (hours)	5.06	5.25
4—Average dead time (hours)	1.25	1.01
5—Average total time (hours)	6.31	6.26
6—Average speed (m. p. h.)	22.3	21.6
7—Average trailing tonnage per train	2,278	2,283
8—Average gross 1,000 ton miles	256.5	255.4
9—Average coal per gross 1,000 ton miles	82.4	114.8
10—Average B.t.u. per pound of coal as fired	12,025	11,160

It can be assumed from the foregoing that the average yearly performance will approximate 100 lb. of 12,000 B. t. u. coal per 1,000 gross ton-miles, or equivalent to what we are promised for the expenditure of billions of dollars of new capital and the loss of billions of dollars' worth of investment in existing plant and equipment to inaugurate the comforts of electrification.

It is also not out of order to refer to dynamometer car tests which it is understood have been made on the New York Central, wherein on the basis of the thermal value of the coal, a single expansion superheated steam locomotive required, per drawbar horsepower hour, about 2.6 lb. of coal as compared with about 2.25 lb. for an electric locomotive.

Efficiency of Locomotive Operation. The off-setting fuel and energy losses, due to standby losses in the steam operation, and decrease in efficiency on account of fluctuating loads in the electric operation must not be lost sight of. Neither should those incident to the transforming, transmission and conversion of electric current and like factors be neglected.

It is unquestionably true that when operating under ideal fixed load conditions, the central power station, either hydro-electric or steam, can produce a horsepower with less initial energy input than is possible on a steam locomotive. It is also true that the standby losses on existing steam locomotives are, in ordinary practice, a serious proportion of the total fuel consumption, but it is likewise a fact that the majority of these can be substantially reduced if not entirely overcome, by modernizing the present equipment and improving maintenance and operation which would then rob the electrical engineers of their main argument in favor of a blanket electrification.

While the electrical engineers and manufacturers in this country deserve great credit for the progress made in the development of the electric locomotive, they have as yet been unable to design one which can operate at maximum efficiency throughout its range of load. The point of maximum efficiency being well established and fixed, and the current curve on an electric motor not being flat, any over or underload from the predetermined maximum efficiency load increased the current consumption. Furthermore, when, on account of transportation conditions, a motor is required to carry an overload for periods of five or six hours, it either breaks down due to heating or otherwise requires special power consuming auxiliaries or long rest periods for the dissipation of the heat stored within itself due to the resistance of the current through the wiring, to permit of continuous operation.

The number of factors entering into an analysis of the net thermal efficiency of the electric locomotive, in terms of drawbar pull, are so many as to make it impossible, with the lack of dynamometer car and laboratory test data, to arrive at a figure which is not based on a number of assumptions; but as a matter of interest, assuming, that *all of the factors are affected equally* in the electric locomotive, the net thermal efficiency at the drawbar, when taking into consideration the boiler, engine, generator, step-up transformer, a. c. transmission, step-down transformer, a.c.-d.c. converter, d.c. transmission, motors, and machine efficiencies may, as representative of average existing practice, be taken as shown in Table 1.

TABLE 1—COMPARATIVE EFFICIENCIES OF ELECTRIC AND STEAM LOCOMOTIVES

ELECTRIC EQUIPMENT

	Efficiency factors and net thermal efficiency, per cent.	Load rating, per cent 100	75	50
Boiler	Factor	.....	.....	.....
	Efficiency	76.7	76	72
Engine	Factor	18.25	18.29	19.17
	Efficiency	14	13.9	13.8
Generator	Factor	90	89.5	86
	Efficiency	12.6	12.44	11.88
Transformer, Step-Up	Factor	98	96	90
	Efficiency	12.34	11.93	10.67
Transmission, A.C.	Factor	90	95	97
	Efficiency	11.10	11.32	10.34
Transformer, Step-Down	Factor	98	96	90
	Efficiency	10.87	10.85	9.30
Converter, A.C. to D.C.	Factor	80	75	63
	Efficiency	8.69	8.13	3.85
Distribution, D.C.	Factor	90	95	97
	Efficiency	7.82	7.71	5.66
Motors, D.C.	Factor	91.5	90.8	89.5
	Efficiency	7.15	7.00	5.05
Machine Efficiency	Factor	81	85	90
	Efficiency	5.79	5.95	4.54

STEAM LOCOMOTIVE

Equipment	Superheated or saturated	Efficiency factors and net thermal efficiency, per cent.	Load rating per cent 100	75	50
Boiler	Superheated	Factor	.....	.....	.....
		Efficiency	42.7	54.9	65.9
	Saturated	Factor	.....	.....	.....
		Efficiency	45.0	57.4	70.0
Cylinders	Superheated	Factor	11.9	11.0	10.5
		Efficiency	5.08	6.04	6.92
	Saturated	Factor	7.8	8.4	7.8
		Efficiency	3.51	4.82	5.46
Machine	Superheated	Factor	75	80	85
		Efficiency	3.85	4.83	5.88
	Saturated	Factor	77	80	82
		Efficiency	2.70	3.86	4.47

Comparing the electric and steam locomotive figures as illustrated, the relative percentage of power delivered at the track rails to 100 per cent B. t. u. in the coal would be:

Kind of locomotive	Net thermal efficiency at load ratings of 100 per cent	75 per cent	50 per cent
Electric	5.79	5.95	4.54
Steam, superheated	3.85	4.83	5.88
Steam, saturated	2.70	3.86	4.47

As 100 per cent load rating conditions would, in practice, occur only momentarily and as the majority of the drawbar load represents from 30 to 60 per cent of the locomotive maximum drawbar capacity, comparison should properly be made only of the net thermal efficiencies at 50 per cent load ratings.

Various dynamometer car and laboratory test performances of representative types of steam passenger and freight locomotives confirm the foregoing figures relating to steam operation. At speeds of from 15 to 75 miles per hour the existing superheated steam locomotive thermal efficiency actually ranges from 5.3 to 8.1 per cent as compared with the calculated figures of from 4.83 and 5.88 per cent for 75 and 50

per cent load ratings, respectively. Adding to this an increase of from 15 to 50 per cent in net thermal efficiency that may be produced from developments now under way, the steam locomotive of the future will be quite a respectable assembly of engineering efficiency.

Cost of Maintenance. In determining the maintenance cost of the electric locomotive the popular error is to take into account the locomotive proper, whereas a true comparison can only be made by including all corresponding elements as found in the self-contained steam locomotive which goes back to the upkeep of all facilities having to do with the utilization of the fuel or water power, including the central power station buildings; boilers; engines; conversion, transmission, distributing and contact line systems; sub-stations; track rail bonding and insulation; electric disturbance cut-outs or neutralizers; extra expense in upkeep of the electric zone trackage; and like auxiliaries and finally the electric locomotive itself.

Peak Load Conditions in Relation to Traffic Requirements. With the steam locomotive the traffic requirements are met by the distribution and utilization of the necessary number of self-contained motive power units as required, regardless as to the capacity of one or more central power stations or of any limitation in quantity, or in price, of the total available power output. The operation of one or of 500 steam locomotives at their maximum capacity at any given moment, or for any duration of time on a single division, is of no concern.

However, in order to meet the ideal conditions for electrification, the traffic should be uniformly spread or scattered over the 24 hr. period, whereas in the majority of cases train movement is based on traveling and shipping conditions and cannot be advanced or delayed in order to eliminate peak load conditions.

Rate of Acceleration. In order that the desired running speeds can be reached in the minimum of time after the starting of trains, the ability of a locomotive to accelerate its load rapidly is of considerable importance and in this respect the electric power has had the advantage. The steam locomotive engineer has, however, not lost sight of this fact and improvements already made in boiler and cylinder horsepower ratios, as well as developments now undergoing for the utilization of existing non-productive adhesive weight and to increase the coefficient of friction between the propelling wheels and the track rails, will enable the steam locomotive to duplicate the performance of its electric competitor in this regard.

Train Braking. Since the development of regenerative braking with the electric locomotive, great emphasis has been laid on the increased security of operation over heavy grade lines due to the ability of the locomotive to hold the train under complete and positive control on the down grade without brakes, by temporarily converting the main motors into generators to produce electricity which is returned to the line for use by some other locomotive in pulling a train. Considerable attention has also been directed to the saving brought about through the elimination of the ordinary air braking on such down grades.

While the regenerative system of braking can no doubt be developed to the point where it can be safely used, in view of the recent serious accident on the St. Paul, due to the failure of the regenerative brake control, just what economy will result is problematical. When the power so generated cannot be directly used by another pulling locomotive on the line, it must be otherwise absorbed, and it remains for the electrical engineers to prove just how much of it is lost in conversion or by absorption and the resulting net gain as compared with the investment, fixed charge and upkeep and operating cost for the equipment involved.

Effect of Weather Condition. Even though the full steaming capacity, horsepower and drawbar pull of a modern steam locomotive can be developed during cold weather conditions, there are the factors of radiation and freezing to be reckoned with, which give the electric locomotive the advantage in winter, particularly, as its effectiveness is greater on account of the lesser tendency for the motors to overheat. This winter advantage, however, is largely overbalanced during the summer when the main motors heat, especially under overloads, and require cooling at terminals or otherwise overheat and result in insulation break-downs or burnouts, or other troubles.

Road Delays and Tie-Up. While the electric locomotive has the advantage of not being required to take on fuel and water, except for the operation of steam heating equipment for passenger trains, with the increased capacity of the modern steam locomotive tenders, and the lower water and fuel rates per drawbar horsepower developed, the delays due to taking on these supplies have been greatly reduced and need not be serious.

Barring collisions, wrecks and like accidents not due to the system of motive power in use, steam operation is not susceptible to complete tie-ups as is the case with electrification, where short circuits or failures occur due to rains, floods, storms and like causes, and as the result of motor, wiring and insulation heating, deterioration and break-downs, as the individual mobility of each piece of motive power without regard to any outside source of power enables quick relief.

Terminal Delays. The examination of reports of a dense heavy freight traffic railroad in the Eastern District shows the time of its steam locomotives for a recent two months' period distributed as follows:

1—In road service..........................	50 per cent of total time
2—At terminals waiting trains and otherwise in hands of Transportation Department....	26.4 per cent of total time
3—At terminals in hands of Mechanical Department	23.6 per cent of total time

There is no doubt that the electric locomotive has an advantage over the steam locomotive as regards time required for periodical boiler work, cleaning and rebuilding fires, fueling and watering except where fuel oil is used, but where terminal delays occur due to waiting for trains, such as the foregoing statement set forth, the time required for such work does not become an expensive determining factor in the daily average miles to be obtained per locomotive.

Hazards. With the establishing of more scientific and careful methods of designing, testing and inspection, and the more extended use of safety appliances, the failures of steam locomotive boilers and machinery, particularly those resulting in personal injury, are relatively low as compared with the work performed. It is, therefore, doubtful if there is any greater proportion of risk from the steam locomotive in that regard than from electrocution and other attendant dangers from high voltage electrification.

FOURTEEN POINTS FOR ELECTRIFICATION

BY A. H. ARMSTRONG
Chairman, Electrification Committee, General Electric Company

A comparison of the modern steam and electric locomotive leads immediately to a discussion of the relative fitness of the two types of motive power to meet service conditions. Place at the disposal of an experienced train despatcher a locomotive capable of hauling any train weight that modern or improved draft gear can stand, at any speed permitted by track alinement regardless of ruling grade or climatic conditions, that can be run continuously for a thousand miles with no attention but that of the several operating crews, and witness what he can accomplish in his all-important task of expediting freight movement. It is not merely a question of replacing a Mikado or Mallet by an electric locomotive of equal capacity. The economies thus effected are in many instances not sufficient

in themselves to justify a material increase in capital account. The paramount need of our railways today is improved service and this can be brought about by introducing the more powerful, flexible and efficient electric locomotive. While a maximum standing load of 60,000 lbs. per axle has been generally accepted for steam engines, it is well known that an impact of at least 30 per cent in excess of this figure is delivered to rail and bridges due to unbalanced forces at speed. Impact tests taken on electric locomotives of proper design disclose the feasibility of adopting a materially higher limiting weight per axle than 60,000 lb., without exceeding the destructive effect on track and road bed now experienced with steam engines.

Accepting the Mikado and Mallet as the highest developments of steam road and helper engines for freight service, the following general comparison is drawn with an electric locomotive that it is entirely practicable to build without in any respect going beyond the experience embodied in locomotives now operating successfully.

COMPARISON ON STEAM AND ELECTRIC LOCOMOTIVES

	Mikado	Mallet	Electric
Type	2-8-2	2-8-8-2	6-8-8-6
Weight per driving axle	60,000 lb.	60,000 lb.	60,000 lb.
Number driving axles	4	8	12
Total weight on drivers	240,000 lb.	480,000 lb.	720,000 lb.
Total weight loco. and tender	480,000 lb.	800,000 lb.	780,000 lb.
Trac. eff. at 18 per cent coef.	43,200 lb.	86,400 lb.	129,600 lb.
Gross tons 2 per cent grade	940	1,880	2,820
Trailing tons 2 per cent grade	693	1,495	2,430
Speed on 2 per cent grade	14 m.p.h.	9 m.p.h.	16 m.p.h
H.P. at driver rims	1,620	2,080	5,570
I. H. P. at 80 per cent eff.	2,030	2,600	....
Trailing ton miles per hour on 2 per cent gradient	9,700	13,500	38,800

In view of the facts, it is a modest claim to make, therefore, that the daily tonnage capacity of single track mountain grade divisions will be increased fully 50 per cent over possible steam engine performance by the adoption of the electric locomotive.

Aside from the power returned by means of regenerative braking (14 per cent of the total on the Chicago, Milwaukee and St. Paul Railway) the chief advantage of electric braking lies in its assurance of greater safety and higher speeds permitted on down grades. The heat now wasted in raising brake shoes and wheel rims often to a red heat is returned to the trolley system and becomes an asset instead of a likely cause of derailment.

Cost of Maintenance

Probably in no one respect does the electric locomotive show greater advantage over the steam engine than in cost of maintenance. Electric locomotives are now being operated 3,000 miles between inspections on at least two electrified railways and the following figures are available.

ELECTRIC LOCOMOTIVE MAINTENANCE, YEAR 1919

	N. Y. C.	C. M. & St. P	B. A. & P.
Number locomotives owned	73	45	28
Locomotive weight, tons	118	290	84
Annual mileage	1,946,879	2,321,148	566,977
Repairs per mile	6.39 cents	14.65 cents	6.48 cents

In contrast, it can be stated that the present cost of maintaining a type 2-8-8-2 Mallet is fully 60 cents per engine mile, without including many miscellaneous charges not shared by the electric locomotive.

Possibly more direct comparison may be better drawn by expressing maintenance in terms of driver weight.

STEAM AND ELECTRIC REPAIRS

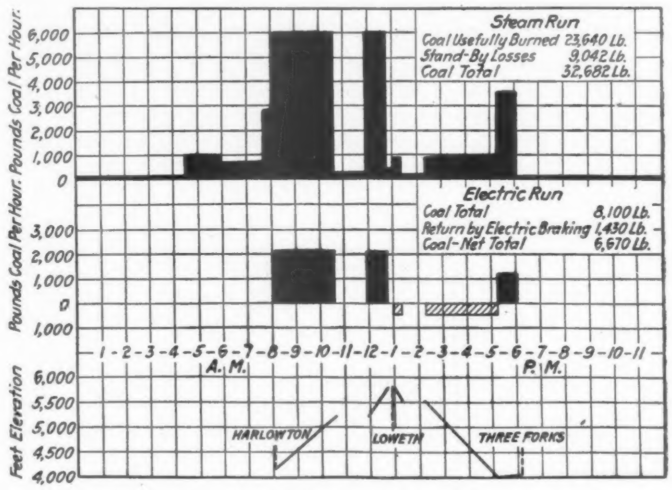
	Steam Mallet	C. M. & St. P. Electric
Cost repairs per mile	60 cents	14.65 cents
Weight on drivers	240 tons	225 tons
Cost, repairs per 100 tons loco. wt. on drivers	25 cents	6.52 cents

Including all engine service charges, the facts available give foundation for the claim that electric locomotives of the largest type can be maintained for 25 to 30 per cent of the upkeep cost of steam engines operating in similar service.

Fuel Saving

Fuel economy figured prominently among the several reasons leading up to the replacement of the steam engine on the Chicago, Milwaukee and St. Paul Railway as brought out by a careful analysis of the performance of the steam engines then in service.

The data indicated on the curves illustrated is therefore submitted as applying to a particular equipment only. No claim is made that it is representative of the best modern



Coal Record on a Basis of 1000 Gross Tons Moved for Steam and Electric Runs from Harlowton to Three Forks, Mont.

steam engine performance, although many thousands of steam engines still in operation will show no greater economies than those given in the following table:

C. M. & ST. P. TESTS—LOCOMOTIVE DATA

	Steam	Electric
Type	2-6-2	4-4-4-4-4-4
Weight of engine	206,000 lb.	568,000 lb.
Weight of tender	154,000 lb.	....
Weight total engine and tender	360,000 lb.	568,000 lb.
Weight on drivers	152,000 lb.	450,000 lb.
Ratio driver weight to total	42.2 per cent	79.3 per cent
Rigid wheel base	13 ft.	10 ft. 6 in.
Diameter drivers	63 in.	52 in.
Cylinders	21 in. x 28 in.	....
Boiler pressure	200 lb.	....
Heating surface	2,346 sq. ft	....
Grate area	45 sq. ft.	....
Water capacity	8,000 gals	....
Coal capacity	14 tons	

The run of 111.1 miles from Harlowton, elevation 4,162 ft., to Three Forks, elevation 4,066 ft., over the Belt Mountain Divide at Loweth, elevation 5,789 ft., was made by steam with 871 ton trailing in 26 cars and by electric locomotive hauling 64 cars weighing 2,762 tons. The fuel furnishing power to the steam train was coal having the following analysis:

COAL ANALYSIS

Fixed carbon	Volatile carbon	Ash	Moisture	B.t.u's
47.99	38.98	8.35	4.68	11,793

Electric power was furnished by water and hence no direct coal equivalent is provided by the test result. To afford a common basis of comparison, however, a single assumption seems permissible and a rate of 2½ lb. of coal per kilowatt hour is taken as representative of fair electric power station practice. Coal burned under the steam engine boiler was determined by weighing at the end of the run and by detailed record of scoops en route. Power input to the electric locomotive was obtained by carefully calibrated recording watt meters as well as curve drawing volt and ampere meters.

Pounds coal per gross 1,000 ton miles may vary on steam locomotives from 650 to 50.5 according to gradient and with no standby losses whatever included. The boiler must be kept hot at all times, however, and fully 33 per cent can

safely be added to include the inevitable standby losses inherent to steam engine operation. Except over very long runs with terminals at the same elevation it seems hardly possible therefore to accurately compare engine performance over different profiles by such a variable unit as pounds coal per 1,000 ton mile.

However efficient the power plant on wheels may reasonably be developed without too seriously interfering with the sole purpose of the steam engine, the hauling of trains, it can never approach the fuel economies of modern turbine generating stations. Whatever transmission and conversion losses are interposed between power house and electric locomotive are more than compensated for by the improvement in the load factor resulting from averaging the very fluctuating demands of many individual locomotives.

Theoretical Comparison Modern Steam and Electrical Locomotives
Harlowtown-Three Forks

	Mikado	Electric
Type	2-8-2	4-4-4-4-4-4
Wt. on drivers	240,000 lb.	450,000 lb.
Wt. engine and tender	480,000 lb.	568,000 lb.
Trac. eff., 18 per cent coef	43,200 lb.	81,000 lb.
Trailing ton, 1 per cent grade	1,420	2,836
Hp. hr. at driver rims	4,360	8,200
Coal per ind. hp. hr	3	....
Coal per driver hp. hr	3.75	....
Standby loss—test result	9,042 lb.	....
Standby loss per hp. hr	2.15 lb.	....
Total coal per driver hp. hr	5.90 lb.	....
Coal at power house, kw. hr	....	2.5 lb.
Coal at power house, hp. hr	....	1.86 lb.
Coal at loco. driver, hp. hr	....	3.09 lb.
Coal credit due regeneration	....	.55 lb.
Net coal at driver hp. hr	5.90 lb.	2.54 lb.
Total net coal	24,800 lb.	20,900 lb.
1,000 trailing ton miles	157,500	314,000
Coal per 1,000 ton miles	158 lb.	66.7 lb.
Ratio coal burned	2.37	1

The above table is based upon actual electric locomotive performance, Harlowton-Three Forks, coal taken at 2½ lb. per kilowatt hour at assumed steam power station. Steam engine values are based upon the known working efficiency of a Mikado equipped with superheaters but penalized with the same standby losses actually determined by test. A test run from Harlowton to Three Forks with a modern Mikado engine hauling 1,420 tons may possibly show a lower average fuel rate than 3 lb. per I. H. P. Hr. at drivers, less standby waste than 9,042 lb. coal, but the average annual performance of many such engines would be most excellent if it reached the net figure arrived at of 5.9 lb. coal per actual H. P. Hr. work performed at drivers. The electric run, however, is being duplicated daily, as to relation between Kw. Hrs. and ton miles and it is just this reliability of electric operation that may at times give rise to misunderstanding in the comparison of steam and electric data.

Comparative Cost

Comparing the cost of equivalent steam and electric motive power, it is apparent that on the basis of the same unit prices for labor and material, the first cost is approximately the same. While electric locomotives cost possibly 50 per cent more than steam for equal driver weight, the smaller number required to haul equal tonnage may quite offset this handicap, especially with quantity production of electric locomotives of standard design.

The steam engine also demands a formidable array of facilities peculiar to itself. This expense covers fuel and water stations, shops and engine houses, shop machinery, turn tables, ash pits, etc. The task of proving the electric case is not made easier by the fact that steam engine facilities are already installed and may have little or no salvage value to offset new capital charge for electrification.

Summary

Some of the principal advantages claimed for the electric as compared to the steam locomotive may be briefly stated as follows:

1—No structural limits restricting tractive effort and speed of electric locomotive than can be handled by one operator.

2—Practical elimination of ruling grades by reason of the enormously powerful electric locomotives available.

3—Reduction of down grade dangers by using regenerative electric braking.

4—Very large reduction in cost of locomotive maintenance.

5—Very large saving of fuel, estimated as two-thirds the total now burned on steam engines in operation.

6—Conservation of our natural resources by utilizing water power where available.

7—Material reduction in engine and train crew expense by reason of higher speeds and greater hauling capacity.

8—Increased valuation of terminal real estate following electrification.

9—Increased reliability of operation.

10—Material reduction in operating expense due to elimination of steam engine tenders and most of the company coal movement, the two together expressed in ton miles approximately nearly 20 per cent of present gross revenue ton mileage.

11—Large reduction in effect of climatic conditions upon train operation.

12—Postponement of immediate necessity for constructing additional tracks on congested divisions.

13—Attractive return on cost of electrification by reason of direct and indirect operating savings effected.

14—Far reaching improvements in operation that may revolutionize present methods of steam railroading.

ELECTRIC MOTIVE POWER FOR TRAFFIC DEMANDS OF TOMORROW

BY F. H. SHEPARD
Director of Heavy Traction, Westinghouse Electric & Manufacturing Co.

With the present standards of train make-up, classification and terminal handling, electrification will double the capacity of any railroad. With the better equipment we can expect in the future, together with the evolution of improved methods of operation contingent on electric power, this capacity should be doubled again, thus securing four times the present capacity. This should certainly be accepted as a vision of the future, and why not our aim? Unless some broad and consistent program is embraced, the situation, which is serious indeed today, may well be calamitous tomorrow. The electric locomotive has generally, thus far, been a mere substitute for the steam locomotive, although, in some cases, due to the greater power of the electric locomotives, there has been a modification of the handling of traffic.

Two conspicuous cases of this have been the Norfolk & Western and the Chicago, Milwaukee & St. Paul. In the case of the Norfolk & Western, two electrics handle the same train as was formerly handled by three Mallet engines, but at twice the speed. In this operation, owing to the great increase in hours of road service as well, one electric locomotive is the practical equivalent of four of the Mallet engines replaced.

On the Chicago, Milwaukee & St. Paul, the notable change has been the elimination of intermediate terminals on the electrified section between Harlowton, Montana, and Avery, Idaho, 440 miles long. There is at present a single intermediate engine terminal, but the latest passenger locomotives are detached from trains at this terminal for inspection and work only, which takes place about once in each eight or ten trips. On regular schedule, these engines make a run of 440 miles each day, being taken off for inspection at Deer Lodge after mileage varying from three to five thousand miles. On occasion, when, due to a schedule derangement, engines have been maintained in continuous road service for periods of thirty hours or more, for a full day of twenty-four hours,

mileage records of up to 766 miles in this mountain service have been established. These records are truly indicative of what may be expected with electric power.

With the retirement of the lighter and weaker car equipments, a material increase in the weight of trains will be realized. Without the limitation in train speed commonly accepted as a handicap to operation of tonnage trains, who can say what the limit to train load will be with electric power? In fact, the character of railroad operation which may be secured with electric power has not yet been visualized. Every other industry that has been electrified has experienced a revolution in methods and service due to electrification. This should be equally true in the case of the movement of our railroad traffic.

Car inspection now takes place at the terminus of each engine district. If, under condition of electric operation, the engine district can be increased to 200, 400 or even 500 miles, is there any good reason why car inspection should not be eliminated at the present intermediate terminals? In fact, is not the general standard of maintenance of equipment of doubtful value on the present basis of inspection at each 100 mile interval? Cars in subway service, which is certainly full of potential hazard, are economically and reliably maintained through inspection at intervals of one or three thousand miles. The elimination of these intermediate terminals, with the resultant necessity of keeping the train moving on the main line, would secure an enormous increase in miles per car with a corresponding saving in equipment.

The generation of power in central stations is surrounded with many refinements, and in the consumption of coal, there is every opportunity for skillful handling and supervision, so that the thermal efficiency of a modern central station is relatively high and is also continuously maintained. With the steam locomotive, on the other hand, the thermal efficiency is dependent not alone upon the design of the locomotive, but the manner in which it is worked, its condition, which differs widely from the best, and finally by the skill in firing. The electric locomotive, on the other hand, consumes power only when in service, and works at any load at its designed efficiency. The average performance, in the case of the electric locomotive approximates the maximum in efficiency, while the steam locomotive, on average performance, will differ widely therefrom.

We can therefore expect that with the best steam locomotives the average coal consumption will be equal to twice the coal rate for the same work performed by electric locomotives with steam generated power. Obviously, with hydro-electric generation, the saving in fuel is complete. There is further economy due to the lesser work performed, because the electric locomotive does not have to trail supplies of fuel and water, nor is there need for the hauling of coal to points of local supply, which will always be greater than hauling to electric central stations.

There are a considerable number of different designs of electric locomotives all in successful operation, and each possessing certain advantageous features. Further experience will, undoubtedly, result in the survival of common types for the different classes of service. The great latitude with which electric locomotives can be designed, while fundamentally most desirable, is in itself at the present time somewhat of a handicap. This is now the subject of intensive analysis and this study is undoubtedly developing, as well, a better knowledge of the running characteristics of the steam locomotive.

To state the case briefly, we are all interested in the transportation problem. Electrification is bound to be the most potent factor for its relief. We should therefore invite and embrace closest co-operation with the engineering and mechanical skill which has been so productive in the steam locomotive field.

Discussion

The discussion of the principal papers took the form of reading prepared discussions some of which are outlined as follows:

H. B. Oatley, chief engineer, Locomotive Superheater Company, stated that while both electric and steam locomotives were undoubtedly able to stand on their own merits, that it was futile to discuss these merits without some idea of what the return on the capital investment will be, in view of the difficulties encountered by the railroads in obtaining capital. Modern electric locomotives must be compared with modern steam locomotives, the stand-by fuel losses of steam locomotives should be compared with similar losses in the power plant, losses inherent to the transmission and transformation of electric power.

F. J. Cole, chief consulting engineer, American Locomotive Company, stated that in the 27 years since the building of the first electric locomotive for operation of the tunnel into Baltimore, only about one per cent of the steam locomotives in this country have been superseded by electrics. Advocates of electric traction fail to produce complete financial statements of installations made and many ill-considered electric suburban lines have been abandoned. Electrically operated roads must have a large excess of power station capacity. A steam locomotive is a more flexible unit than an electric locomotive and a steam-operated road is not subject to tie-ups due to burned out cables, blow-outs, etc. Much of the fuel economy claims made for electric operation are based on unwarranted assumptions.

Facts Relating to Regenerative Braking, Fuel Economy and Maintenance

C. H. Quinn, chief electrical engineer (N. & W.) said that if we are to maintain our standing in the commercial world, our railroad facilities must go forward and keep pace with the commercial development of the nation and that for this reason effort should be concentrated on the development of freight locomotives which can meet coming requirements. Freight car capacities, he showed, have increased 100 per cent during the past ten years, while steam locomotive capacities have increased only 10 per cent. By comparing fuel consumption of the electrified division of the Norfolk & Western with tests made on modernized Mallet engines under similar operating conditions, Mr. Quinn showed a fuel saving of 29.3 per cent in favor of electric operation. In answer to a query on regenerative braking, it was pointed out that during the past five years twenty thousand 3,250-ton trains have been taken down a 2.3 per cent grade, using only regenerative braking, without a single failure.

A. L. Ralston, mechanical superintendent (N. Y., N. H. & H.) compared the thermal efficiency of the 3,000-volt direct current system with the efficiency of the electric locomotive as given in Mr. Muhlfeld's paper. It is stated that on the New Haven, the efficiency at full load was 8 per cent; at 75 per cent load, 7.8 per cent; and at 50 per cent, 7.4 per cent. To prove greater reliability of electric service, he cited the fact that there was only one failure for every 21,000 miles run by electric locomotives and a failure for every 4,000 miles run by steam locomotives. He stated that the records of the New Haven showed that in slow freight service, approximately 25 kw. hours were consumed per 1,000 gross ton miles in freight service. The coal per kw. hour averaged 2.92 lb. and the line loss was 7.1 per cent. The fuel consumption in passenger service was 9.3 lb. per car mile on the electric division while the average for steam operation on the New Haven was 19.3 lb. per car mile. With coal costing $5.00 a ton, the net saving through electrification was $393,000 a year.

In freight service, electric locomotives consumed 84 lb. of coal per 1,000 gross ton miles while steam locomotives aver-

aged 199 lb., the saving in this service being $268,000. In switching service, the consumption of electric locomotives was 38.3 lb. per mile and for steam operation, 106.8 lb. per mile, a saving of $94,000. The electrification was therefore responsible for a gross saving in the cost of fuel amounting to $755,000 annually.

The opinion was expressed by W. F. Kiesel, Jr., mechanical engineer of the Pennsylvania, that electric operation does not save coal and he produced figures obtained from locomotive tests to substantiate his opinion.

F. H. Hardin, chief engineer of motive power (N. Y. C.) stated that electric locomotives require back shop facilities as well as steam locomotives. Figures shown on the maintenance costs of New York Central Mallet locomotives, including shop and engine-house repairs, were from 24 to 37 cents per mile as against the estimate of 60 cents offered by Mr. Armstrong, and Mikado locomotives on the N. Y. C. show a fuel consumption of 125 to 130 lb. of coal per 1,000 gross ton-miles as against the estimate made by Mr. Armstrong of 158.

Broad Features Outlined

W. L. Bean, assistant general mechanical superintendent, while speaking for the steam men, presented an unbiased discussion based largely on his own experience. The following is an abstract of his remarks:

The prime factor to be considered in any engineering enterprise of commercial nature is the economic result of the entire specific project. Results of sub-projects in themselves are important and consideration sometimes of a multitude of factors of minor or more than minor nature must be sufficient, even to the last detail, but partisanship in championing some of the sub-factors to the exclusion of others is undesirable and of course does not represent the best of engineering procedure.

It must be conceded broadly that electrical operation requires less coal per unit of traffic handled than steam operation. How much less depends on the specific conditions. Likewise, the mileage per unit of electric equipment is ordinarily greater per unit of time. On one largely electrified road, express locomotives average 27 per cent more miles per day per locomotive owned than steam power in similar service. However, the first cost of the electric engines per unit of capacity was 84 per cent greater than in the case of steam. Therefore, the fixed charges are greater for the electric engine per unit of service.

A few words respecting comparative flexibility, especially in service of a character which demands it, may be of interest. A certain modern passenger electric locomotive will handle a heavy train of Pullmans at high speed on a through run with few stops such as would require a modern Pacific type steam engine of about 43,000 lb. tractive effort. However, to operate the electric engine in heavy local service over the same distance is impossible because of the heating caused by frequent starting. In such service, the maximum train which can be handled by the electric locomotive can only approximate what can be handled by a steam engine of about 30,000 pounds tractive effort.

Realization of the extent of accumulation of wear and tear, both electrically and mechanically, makes it difficult to understand just how railroads are to maintain electric locomotives without back shops unless they job the work out to manufacturers of electrical equipment.

Regarding the design of the machinery of a steam locomotive being utterly circumscribed by the necessity for tying it up to a steam boiler, the statement can be made that some modern high powered electric locomotives are so compact with apparatus, both inside the cabs and beneath, as well as on top, that additions to or enlargements of details, even of a minor nature, are well nigh impossible. Furthermore, this is not peculiar to AC-DC machines.

When one comes to attempting the solution of the problems attendant on the heating of passenger trains, electrically drawn; to find room for the boiler, water and fuel oil storage auxiliaries, etc., and keep within weight limitations, the difficulties are very real and certainly lead one to the conclusion that on electric passenger power the boiler is circumscribed by electrical apparatus.

It appears that when a railroad goes in for electrification, it must settle on some type of lay-out, the main characteristics of which are fixed. Extension must either be along the original plan as to power characteristics, distribution or collector apparatus, or else vast sums must be spent to re-vamp the existing plant if the new lay-out is not to be largely separate and independent with all of the inherent disadvantages of non-interchangeability and lack of flexibility.

The steam locomotive, except in a moderate way as to clearances and weight limits, has a wide range of application. Railroads loan steam power back and forth with advantage usually to both parties, but no case comes to mind where electrical equipment for heavy traction can be interchanged.

The design and operating characteristics of steam power have developed far more along lines of possible common usage and practice. It is to be hoped that the lines of development of electrical facilities will tend to converge rather than diverge too widely.

Tangibles from a money standpoint can and should be segregated and set up in full scope on both sides of the case and conclusions based on the net result at the bottom line of the balance sheet. If fixed charges on plant, including equipment, plus maintenance charges, plus other out-go, outweigh the savings in fuel, plus other operating savings, the net result is a deficit and all manner of proclaiming isolated pecuniary advantages would not induce a careful investor to support the enterprise.

Discussion by A. W. Gibbs

After reading the papers on steam versus electric operation of railroads, I cannot but feel that both Messrs. Muhlfeld and Armstrong have been a bit too enthusiastic. Both methods of operating have their advantages and both have decided limitations.

In Mr. Armstrong's case his data is largely derived from mountain electrification, where the electric locomotive is undoubtedly at its best and the steam at its worst, and he has compared with it a type of steam locomotive whose coal and water rate is more than double that of locomotives which are especially designed for such service. Then on this mountain performance he reasons from the particular to the general application of electric operation. True, he puts in a disclaimer as to the particular steam locomotives referred to representing the best modern practice, which brings up the question—Why cite them at all?

It is not at all certain that the speed advantage claimed is by any means true where the steam locomotive is designed for the work.

Mr. Armstrong gives a comparative statement of the performance of two steam and one electric locomotive to which exception can be taken because the steam locomotives do not represent the last word as to those available, and the electric locomotive is on paper.

The table shown herewith gives data for a 2-10-0 type steam locomotive of which over 100 are in regular service and of which fortunately very full information is available from the locomotive testing plant. These locomotives were expressly designed to do all of their work within the economical range of steam distribution, the required power being obtained by increases in size of cylinders and steam pressure. While I have given the power at nearly the speed mentioned by Mr. Armstrong, the performance is excellent at double the speeds given, but the sacrifice in drawbar pull—from nearly

60,000 pounds at 14.7 miles per hour to about 43,000 pounds at 25.3 m.p.h.—would not be justified. The figures given are within the range where stoker firing is as economical as expert hand firing, with the additional advantage that the stoker does not get tired.

This is a special design in which the advantage is that it cannot be worked at uneconomical points of cut-off. At speeds and pulls where the usual design is also worked at an economical range its performance is about the same.

2-10-0 Type Steam Locomotive

Weight in working order	371,000 lb.
Weight on drivers	342,050 lb.
Weight on engine and tender	532,000 lb.
Drawbar effort at 14.7 miles per hour, 45 per cent cut-off	58,900 lb.
Gross tons (2 per cent grade)	1,280 lb.
Trailing tons	1,019
Coal per D. H. P. at this speed and cut-off	2.8 lb.
Tractive effort at 22 miles per hour, 40 per cent cut-off	42,500 lb.
Gross tons	923
Trailing tons	662
Coal per D. H. P.	3.2 lb.
Tractive effort at 25.4 miles per hour, 45 per cent cut-off	43,600 lb.
Gross tons	948
Trailing tons	687
Coal per D. H. P.	3.8 lb.

The Mallet performance given in Mr. Armstrong's paper is evidently that of one of the large compound locomotives. In all of these locomotives there is a tendency to choke up with increases of speed, due to increase of back pressure.

The same arrangement of limited maximum cut-off used in the 2-10-0 locomotive already described has been embodied in a simple Mallet now running. In brief, the improvements in the steam locomotive, if properly availed of, have much narrowed the field of economical electrification.

Stand-by Losses. While these losses are actual and large it is very difficult to fix their value, as they are so much affected by the use made of the locomotive. Where the average monthly mileage is low the stand-by loss is presumably high, and it is a part of good operation to bring up the average mileage as high as possible. When all is said the electric locomotive has still an advantage with respect to stand-by losses, provided there are sufficient trains in motion to smooth out the total demand on the power plant, which is assumed to be steam operated.

Weather. The independence of the electric locomotive of severe weather is another undoubted advantage, not so much because of the performance of the motors but rather from the avoidance of losses and delays due to ash-pit work and to frozen pipes and other parts, incidental to the presence of water on the steam locomotive.

Liability to Interruption. Electric operation is dependent on uninterrupted connection with the source of power. In the event of breakage of the line, especially of the overhead construction, the trains in the section involved are dead and cannot get themselves out of the way of the repair trains. On large systems it is customary to make great changes in the assignment of locomotives to clear up congestion at any point on the system; also, to avail of diversion routes on which steam trains may be moved around obstructions on the main line. The fact that the steam locomotive is a self-contained power plant is an immense advantage in this respect. In electric operation there is not this freedom of movement.

Speeds. The question of speed is evidently treated from the freight standpoint, for there has never been any question as to the speed capacity of well designed passenger locomotives, being far beyond that permitted by the rules. As I see it, the feature of high speed of trains is of less importance than uniformity of speeds of different trains. If tonnage trains had the same speed as preference trains, and could thus avoid the great delay due to side tracking of trains of inferior rights, far more would be accomplished than the mere saving in time over the division due to the increased speed.

Extent of Electrification. Where electrification is contemplated a very serious question is: What shall be its extent? Naturally the desire would be to wipe out as many as possible of the extensive accessories to steam operation. If, however, it becomes necessary to operate steam trains over the electrified section, it will obviously be necessary to retain water stations and possibly fuel stations, provided the electrified section is sufficiently long. This operation of steam locomotives under their own power over electrified sections would be necessary in case of redistribution and possibly in case of diversions where the electrified section formed part of the diverted line. Therefore, the claim for economy in doing away with these features of steam operation would probably not be realized.

Mr. Muhlfeld's Paper. Mr. Muhlfeld ignores the fact that the modern improvements which have so added to the performance of the steam locomotives are potential only. It is common for instance to so carry water in the boiler that the superheater becomes merely a steam dryer and its value disappears. In many cases because of neglect of damper mechanism or from dirty flues little benefit is derived from improved appliances. Modernizing of steam locomotives calls for intelligent use of these devices.

Conclusions. The electric locomotive or electric operation has in many cases undoubted operating advantages because the power is generated in quantity at few sources and the power on any one train is not limited by the capacity of a self-contained portable power plant; sustained speeds are possible due to independence of fuel and water stations and, as a result of both these conditions, better use can be made of a given stretch of road.

Electrification does not at all obviate the numerous class of delays due to the train itself, such as hot boxes or other of the numerous derangements which when combined so much retard the movement over the road. Electrification does not obviate that class of delay arising from necessary classification on line of the road to meet terminal requirements. Where the terminal conditions limit the capacity of the road as a whole electrification is not the remedy.

The relative cost of repairs of both classes of equipment cannot be fairly stated at the present time because maintenance conditions are so abnormal and because the most modern locomotives of both classes are too new to have reached a stable condition, this being especially true of the electric one. While the indications are that the maintenance of the electric locomotive will be less than that of the steam, it must be remembered that the electric locomotives are dead affairs without the necessary electric generating, transmitting, converting and track appliances, all of which are an added expense, due solely to electrification; hence the cost of maintence of all of these, in addition to that of all of the locomotives, divided by the locomotive mileage, is the real treasury cost of maintenance per locomotive mile.

It is to be noted that practically all of the electrifications on steam railroads so far have been based on local conditions. In the electrifications in and around cities a moving cause has been the elimination of smoke and other objectionable features incidental to steam operation, and the possibility of increasing the capacities of the passenger terminals. On the Milwaukee road it was the utilization of available water power. On the Norfolk & Western it was to secure increase in capacity on a congested mountain division with tunnel complications.

If, after careful consideration of the road, based on actual train sheets for the heaviest actual or probable congested operation; the capacity and number of active and available locomotives required; crediting the operation with incidental savings which may be effected, and eliminating expenses peculiar to steam operation; it appears that there would be economy in electrification, either from actual savings or better operations, or both, it still remains for the management to decide whether the money required can be spent to better advantage for electrification than for some other features.

LOCOMOTIVE TERMINAL AS AN OPERATING FACTOR*

Satisfactory Locomotive Operation Dependent On Adequate Locomotive Terminal Facilities

BY L. G. PLANT

Associate Editor of the Railway Mechanical Engineer

THE importance of the locomotive terminal as an operating factor lies clearly in the fact that both the quantity and the quality of work performed by every locomotive depend wholly upon the character of the attention which it receives at the end of the run. The most efficient locomotive may become wasteful or the most powerful locomotive be incapacitated by careless handling or neglected maintenance at the locomotive terminal. When we stop to consider that the average locomotive spends the better part of each day in the terminal and that its ability to render useful service during the remaining hours depends upon the car which it has received at the terminal, it must be evident that the locomotive terminal is a very live factor in the operation of any railroad.

The effect which a terminal can have upon the performance of every locomotive is so very obvious that any broad plan for the betterment of operating conditions must take into consideration the question as to whether a further expenditure in terminal equipment or improvement in terminal methods will not enable us to get more useful work out of our locomotives without a corresponding increase in operating expenses.

We are today operating bigger locomotives than were thought practical twenty years ago and some of them are equipped with devices designed to increase the efficiency and capacity of the locomotive beyond what was considered possible ten years ago. But we are handling many of these locomotives through terminal lay-outs and in enginehouses that were designed over thirty years ago with small margin for subsequent development. Thirty or forty years ago the locomotive terminal was hardly regarded as an operating factor; other causes determined the hours that a locomotive was available for service and there were fewer repairs required in the roundhouse because the locomotives were subject to less intensive operation, because all of their parts were much lighter and because of the willingness with which the engineers co-operated in those days in the maintenance of their locomotives.

Function of the Locomotive Terminal

This brings us to a consideration of what is now the function of a locomotive terminal. It must, in the first place, afford adequate current maintenance. It may be possible and economical to concentrate the larger share of this burden at one of two adjacent terminals, but there are few terminals at which locomotives can be regularly turned without requiring the attention of mechanics. It may also be anticipated that the inspection required by the government will grow more insistent so that there are practically no locomotive terminals today in which adequate maintenance is not regarded as the foremost problem.

Generally speaking, terminal maintenance should be of such a character that the locomotives will continue to operate at full capacity and maximum efficiency between shoppings. Not only this, but the organization and facilities at every terminal should be adequate to keep all locomotive fuel and labor saving devices in working condition. Inability to properly maintain such devices with the terminal facilities on many railroads has been one of the most serious conditions tending to limit their full field usefulness. It is inevitable that locomotive terminals will be called upon to execute an increasing variety of heavy repair work, and it is imperative that they be so equipped that this work can be done without infringing on what may be described as the routine functions of the enginehouse.

The assignment of one or more stalls in a busy roundhouse to locomotives undergoing heavy repairs where the facilities are inadequate and the work consequently allowed to drag indicates a failure to comprehend the true function of a locomotive terminal. But, on the other hand, if the facilities are such that this work can be done expeditiously and economi-

*From a paper presented before the New England Railroad Club on November 9, 1920. An abstract of the concluding portion will appear in a subsequent issue of the *Railway Mechanical Engineer.*

cally this will do more than any other factor to prolong the useful service of locomotives between shoppings as well as lessen the ultimate maintenance cost.

Importance of Prompt Terminal Movement

A locomotive is of value only when it is performing useful work, and as it can only perform useful work when it is in service, it is startling to note how small a percentage of time locomotives on many railroads are in actual service even when traffic demands are very heavy. This is not necessarily a situation for which the mechanical department is responsible as the manner in which the power is dispatched by the operating department may cause much lost time. But terminal management and the terminal facilities at the disposal of the mechanical department are in most cases the controlling factors.

The cost of a locomotive is no index to what its actual value to the railroad company may be. If it is not a modern locomotive and the demands for power are such that it can be spared from active service it is valueless for the time being and should be stored for some future emergency. If on the other hand it is an efficient unit and the demands for power are pressing, it may easily be worth one hundred dollars for every hour that it is in active service. The value of locomotives will inevitably increase, and with an era of intensive railroad operation before us, we are unquestionably facing the ultimate pooling of all locomotives.

These facts only serve to emphasize the tremendous importance of speed in terminal operation. The function of the locomotive terminal is not only a matter of maintenance, but the execution of repairs and the routine operations of fire cleaning, coaling, sanding, washing and so on, within the shortest possible time. The significance of the prompt execution of these functions will be more fully appreciated when applied in principle to any railroad on which the demands for power are particularly heavy. Assuming that 1,000 locomotives are in service on an average of ten hours each day; if the terminal detention could then be reduced an average of one hour per day, this would be equivalent to an immediate increase of 100 locomotives in the number available for service.

It is the physical equipment, the organization and management of the terminal that determine its capacity to fulfill these important operating functions. Each new terminal development presents a unique problem which can best be solved by engineers acquainted with local conditions.

Essentials of Terminal Equipment

The essential features of locomotive terminal equipment may be roughly divided into outside equipment including the track lay-out, fire cleaning facilities, coal chutes and sanding apparatus; and the equipment which is distinctly a part of the enginehouse and adjacent shops. Where lack of foresight has not set a limit to the space available for expansion, trackage should be expanded to the fullest extent possible. A single track lead over which locomotives move to and from the roundhouse is inexcusable. Where trackage is ample, a well-defined routine for the movement of every locomotive can be strictly adhered to. With three or more tracks available, a majority should ordinarily be assigned to in-coming locomotives. As a general rule a number of short leads are preferable to a single long lead, as this enables one locomotive to move independently of other locomotives. Where the number of leads is restricted, frequent cross-over switches should be placed so as to reduce the liability of blocking the movement of any locomotive.

From an operating standpoint, the relative merits of various means for coaling and sanding locomotives may be gaged principally on the basis of reliability and capacity. Since the operation of these facilities reflects an operating charge, it may be well to consider the relative cost of operation, but this is not a circumstance to the necessity for reliability in operation and capacity, not only for the total daily quantities of coal and sand, but for the number of tracks served. While there may be some advantage in locating these facilities so that coal and sand may be taken together, there is apparently no real necessity for this, as it is not usually practical to deliver both coal and sand without moving the locomotives during the operation.

The arrangement of fire cleaning facilities and ash handling apparatus is undoubtedly the most vital feature exterior to the enginehouse. Whereas the time consumed in taking coal and sand can hardly be in excess of ten minutes, the time over the ash pit may easily consume one or two hours unless this movement is subject to the strictest supervision and the facilities are reasonably adequate. And yet these facilities at a very large number of so-called locomotive terminals are of the most meagre and primitive character.

Important Details in Terminal Equipment

No single feature about the terminal shows a greater variety in design than the locomotive ash pit. While we are accustomed to everything from an ordinary stretch of track on which the ashes are unceremoniously dumped, to extensive subterrannean vaults from which the ashes are removed by mechanical conveyors, I am inclined to think that the water pit with a single gantry crane spanning three or four locomotive tracks and a single cinder loading track will prove to be the ultimate type best suited to meet the demands of intensive terminal operation. The transverse pit serving several tracks is preferable on general principles to the longitudinal pit serving but one or two long tracks. It may be stated that in the most recent terminal projects where space could not be regarded as a limiting factor, short transverse water pits serving three and four locomotive tracks are decidedly in vogue. In any event, the locomotive ash pan should be accessible to fire cleaners working on either side of the locomotive. This may be accomplished on water pits by spacing the locomotive tracks close enough together so that light movable platforms may be used between them or by providing an individual water pit with each locomotive track that is spanned by the crane.

Against the possibility of a break down on the part of the ash pit crane, a locomotive crane should always be available. In fact, the locomotive crane, ready for any emergency and capable of doing many things, must be regarded as indispensable to the operation of any real locomotive terminal.

The washing of locomotives with oil, water and compressed air appears to be an accepted time and labor saving practice. Some of the best results observed in cleaning locomotives by this process are noted at terminals where during the day shift every incoming locomotive is washed off en route from the ash pit to the enginehouse. Two men were engaged in the operation, which ordinarily does not delay the locomotive to exceed five minutes. This method would seem to have advantages over the practice of washing locomotives periodically and doing this in the enginehouse.

Enginehouse Design and Equipment

From an operating standpoint it may be said that there are some facilities which are indispensable to the enginehouse while the necessity for certain machine tools and other special equipment might depend upon the proximity of the terminal to the backshop. With the increasing weight of locomotives and growing appreciation of the value of every locomotive service hour, we are faced, however, with the practical necessity of doing more and more heavy repair work in the locomotive terminal.

It is important, therefore, that in all new terminal projects this situation be taken into account and the enginehouses be fully equipped for any repairs that may reasonably be anticipated. In some of the most recent and important terminal

developments, the enginehouse in reality approaches the modern erecting shop in design and equipment. These roundhouses comprise about thirty stalls occupying approximately a semi-circle. The depth of the house is 115 ft., having a cross-section which resembles that of an erecting shop of a three-bay construction. This includes a lofty bay in which a 75 ft. 15-ton crane operates along the outer side of the house and two lower bays at the turntable side. The outer wall, which rises to a height of nearly 40 ft., is comprised almost wholly of steel sash, which, together with continuous monitor windows 15 ft. in height over the lower bays, provides unsurpassed natural illumination.

Adjustable standpipes, resembling water cranes are located between the stalls in such a position that they may be fitted over each locomotive stack. All smoke and gases are then removed by means of a down draft system, so that there are no smoke jacks to interfere with the operation of a crane throughout the entire circumference of the house. This down draft feature is also relied upon in building fires, thus eliminating the use of the steam blower and blower lines. While a blower fan is installed to create the necessary down draft, the stack erected outside of the house is of sufficient height to effect a strong natural draft when the fan is not in operation. Separate drop pits to serve trailing, main and and engine truck wheels are installed. The machine tool equipment at these terminals ranges from a comparatively small number of machines located in an annex to the roundhouse to a full complement of heavy machine tools in an adjacent erecting shop. The annex equipment includes a wheel lathe, boring mill, planer, motor driven lathes and unwheeling hoist, while the shop adjacent to other engine houses has the traveling crane and other equipment conventional to erecting shop lay-outs.

In fact, it is not beyond the range of possibilities to conceive of a development in locomotive terminals along these lines that would supersede many of the functions of the central erecting shop. While this is a subject more closely related to locomotive maintenance than to operation the question may well be raised as to whether better results could not be obtained from an operating as well as a maintenance standpoint if facilities were such that it would be practical to keep locomotives in good condition by frequent and adequate terminal repairs than by executing only the most urgent repairs in the terminal and relying largely on periodical backshop operations.

The Most Important Facilities

Of the particular features regarded as essential to the most successful operation of terminal enginehouses, those which tend to reduce labor costs are of the first importance. On this ground a traveling crane or electric tractor that would have been considered an extravagance ten years ago might well be regarded as a necessity on the basis of present labor costs.

Splendid results, however, can be obtained by equipping the roundhouse with two jib cranes between each stall located so as to swing over both ends of the locomotive boiler. It is entirely practical to build a jib crane with a toggle joint which will enable it to swing in a complete circle of 15 ft. radius about the column (as described in the August, 1920, issue of the *Railway Mechanical Engineer*, page 544) and to equip these jib cranes with two ton chain hoists. In fact, some foremen would prefer a roundhouse well equipped with jib cranes of this character to having a traveling crane where the repairs required are not too heavy.

The only definite suggestion which can be advanced in regard to this feature of roundhouse equipment is that in all new projects where the development is on an extensive scale the enginehouse should be made ample in size and equipment to allow for a wide variety of repair work without interference with the routine operating functions. The equipment in such cases should include the overhead traveling crane and downdraft ventilating apparatus. Where the activities of the enginehouse are limited to routine operating functions, the use of jib cranes are satisfactory and, if supplemented by an electric monorail or storage battery tractors, will meet every practical requirement.

Nothing need be said in regard to drop pits further than that they, or the equivalent in the form of an unwheeling hoist are essential to any locomotive terminal responsible for the maintenance of power in satisfactory running condition between shoppings. A number of well arranged drop pits are preferable to a single unwheeling hoist in the roundhouse, but where an annex is designed to care for the heavy repair work originating in the terminal, the unwheeling hoist would appear to be the most practical apparatus for such shop facilities.

It may also be said in a general way that the heating of enginehouses by steam or air even in the southern states is essential and that good ventilation and lighting are very important. Good floors will further contribute indirectly to the prompt movement of power through the enginehouse. The operation of the hot water washout system, on the other hand, has a direct effect on the operation of the railroad by reducing the time locomotives must be held in the enginehouse as well as exercising a very wholesome effect on boiler maintenance, and no locomotive terminal is in any sense complete without this equipment.

KINDS OF FUEL AND OPERATING COSTS*

In order to get the greatest return from money invested and the maximum of efficiency, it is necessary to have complete co-operation among the departments chiefly concerned in the purchase, inspection, distribution and handling of coal. Any failure of one or more departments to fully co-operate with the others in any particular feature or situation concerning fuel, exposes that railroad directly or indirectly to a loss. The effect of the changing grades of coal is soon felt, both on the performance of the engine and the operating costs. One of the most important effects is on the morale of the men. The modern locomotive long ago reached a size that is above the limit of human endeavor to fire by hand and also give the care and attention necessary for the economical use of fuel when different kinds are being continually furnished.

From an economical standpoint, prepared coal, even at a higher cost, is best, due to the elimination of delays caused by steam failures, and it is better adapted for stoker service, on account of being the proper size and free from foreign materials. In many cases the firemen do not break lumps to the proper size and remove foreign material before feeding the unprepared coal to the stoker.

With a grade of coal of a low heat value, and the locomotive equipped to handle it economically and successfully in short haul or local service, when the same uniform grade of coal is regularly furnished, the operating cost can be maintained at a minimum and a satisfactory service guaranteed. It has been proved that, with locomotives so equipped, when it became necessary to furnish them with a grade of coal of a higher heat value the cost of operation in the same service increased far more than the difference in the cost of coal, due largely to the draft of the locomotive and the lack of care and co-operation of the engine crews after the change of fuel was made.

With a grade of coal of a high heat value, usually furnished for long haul, heavy or first-class service, and with locomotives equipped to handle it economically, after a long established and satisfactory service has been maintained at

* From a paper presented at the convention of the Traveling Engineers' Association.

a minimum cost, this same service has been badly disarranged and the cost of operation largely increased when it became necessary to substitute a grade of coal of a low heat value to locomotives so equipped. In this case operating costs are increased because of the additional supervision necessary in the operating department, extra help necessary at intermediate points, extra pay to engine crews for fire cleaning, ash-pan cleaning, etc., required operating agreements, which accrue before changes in the construction of the equipment can be made. Added to this is the maintenance of the engine.

Because of the scarcity of coal at the present time, railroads are using a large amount of commercial or confiscated coal, which disrupts the regular assignment and raises the price per ton far above the regular contract price.

Some mechanical coaling stations have a tendency to separate run-of-mine coal so that lumps will all be on one side and fine coal on the other. Nothing is more discouraging to a fireman than to go out on the road with a heavy hand-fired locomotive supplied with fine coal and then see a yard engine coaled with clean lumps.

We recommend standard nozzles, front ends and equipments, but it is impossible to maintain them as standard without some knowledge of the character of the coal to be used, as it requires time (which is money) to make changes in locomotives to meet requirements of frequently changing coal. After locomotives are once equipped to handle a certain grade of coal, it is impracticable to be continually changing the front ends to suit different grades.

Distribution

It is a prevailing practice that fuel distribution be left in the hands of the fuel accounting or purchasing department. This practice is approved by the committee when coal of the same grade or heat value is purchased exclusively; but on any division or system where various kinds of coal of different grades are used and the grade and quality of the coal are known, the distribution should be under the direction of the officers of the locomotive department, who maintain the power and know its condition and are better able to state where various grades can be used to the best advantage.

An important feature of fuel distribution is to order and insist on the proper kinds of cars. It means an item of increased expense when the unloading has to be done contrary to the usual method.

Pulverized Coal

For good financial reasons, during the war period the railroads practically abandoned experimenting with and using pulverized coal. No doubt in the near future they will give this subject deserved consideration. Experiments made in the past seem to prove that there is much merit in the use of coal prepared in this manner. While many are enthusiastic relative to its merits, the committee has been unable to get any definite information of statistics relative to its regular use in locomotive practice.

Storage

Storing should preferably be done at the coaling stations or power plants, but when this cannot be done, coal should be stored as near to the point of consumption as possible.

So far as it can be brought about, only one kind of coal should be stored in the storage pile. Experience indicates that mixed coal loses more of its value and is more liable to spontaneous combustion while in storage than coal of one kind, under the same conditions. Chemical tests show losses of from one to five per cent if coal is kept in storage for periods from a few months to several years. Stored coal may not ignite as quickly as fresh coal, although there may be no difference in the B.t.u. value by test.

Oil

With the increased demand for domestic crude oil, from which nearly all of our lubricating oils and greases are made and upon which even the industrial life of the nation depends because of the great increase of internal combustion engines that can use no other fuel, it becomes almost a crime to waste this grade of crude oil as a steam producer, in so far as railroads are concerned. Unless greater fuel oil deposits are discovered and the cost of production decreased, which does not seem possible at this time, the most recent statistics on the production, storage and consumption of oil as a fuel clearly indicate that the day is not far distant when it will be prohibitive for locomotive use and it will become necessary to use some form of power obtained from a lower grade of fuel.

The report was signed by J. A. Mitchell (N. Y., N. H. & H.), chairman; E. F. Boyle (Sou. Pac.), H. H. Kane (Sou. Pac.) and G. V. McGlinch (M. C.).

Discussion

It is evident that the shortage of coal for the past year has led to extremely unsatisfactory conditions with respect to locomotive fuel and these conditions have clearly demonstrated the desirability of the maintenance of a uniform supply of coal on each division.

Several systems of distribution were briefly described. On the Louisville & Nashville coal is billed direct from the mine to the division, each division thus securing a uniform quality of coal, always from the same mine. Where coal is shipped from off the line, however, this practice was objected to and some system of distribution after the coal is received on the line seems to be necessary.

The abuse of the reconsignment privilege was referred to as one of the causes of coal car shortage, the cars thus being tied up under load so far that in some cases the roads are unable to get cars for their own coal and must confiscate anything available.

Referring to the difficulty of securing uniformity in the distribution of coal under present conditions Robert Collett described the method being employed on the New York Central. A statement is issued periodically showing the distribution as it should be made, in comparison with the actual distribution and giving the per cent of incorrect distribution. This served as a lever to bring about improved conditions.

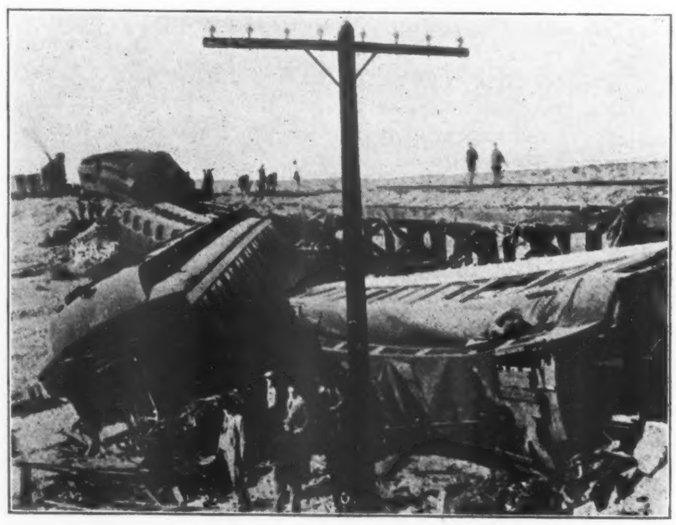
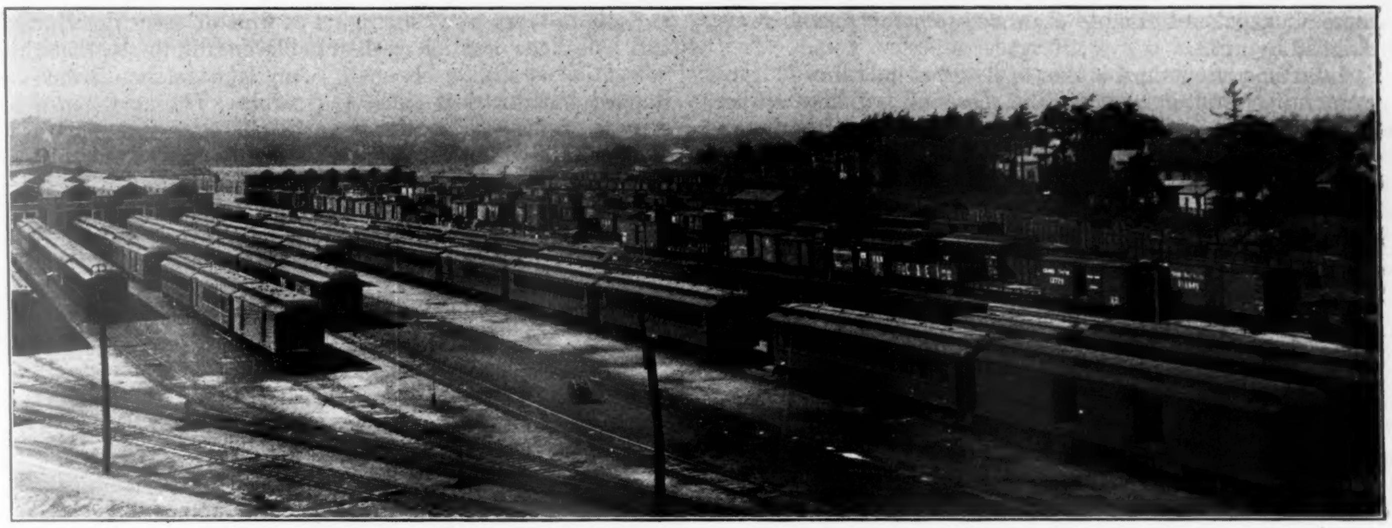


Photo by International

An Accident Near Manx, Nevada, Due to Spreading Rails in Which the Entire Train Left the Track, Causing Four Deaths



A View of the Readville Shops of the N. Y., N. H. & H.

Closing Sessions of C. I. C. I. & C. F. A. Convention

Handling Tank Cars, Loss and Damage, Passenger Car Maintenance and A. R. A. Billing Discussed

The proceedings of the opening sessions of the convention of the Chief Interchange Car Inspectors' and Car Foremen's Association were published in the November issue of the *Railway Mechanical Engineer*. At the conclusion of the discussion of the Rules of Interchange, as reported in the previous number, President Gainey introduced J. E. Grant and T. J. O'Donnell, special agents of the Bureau of Explosives, who addressed the convention.

DUTIES OF CAR INSPECTORS IN HANDLING TANK CARS

BY J. E. GRANT

No other rolling equipment of the American railroads today claims as much attention from the Bureau of Explosives as the tank car. It represents the development of a shipping container by means of which more lading of a character classified as dangerous by the regulations of the Interstate Commerce Commission and Canadian Railway Commission is transported than in any other way.

There is no class of car which should have the careful attention of a car inspector on the line or at an interchange point more than the tank car, and in view of its great importance in freight traffic, it will be interesting to trace briefly its development.

Tank cars are in a distinctive class from the fact that notwithstanding the enormous volume of their traffic, they are almost entirely privately owned. Of a total number estimated at about 125,000 the railroads own only about 15,000 of these cars.

Their range of ownership among the users themselves resulted during the first years of their existence in construction along the lines of individual ideas and until the year 1902 not much attention was paid to details of strength, materials or design provided they were mounted on frames and running gear capable of holding up in the general stream of freight traffic. In that year, 13 tank cars of naphtha were involved in an accident and as the result of the fire and explosion of several of the cars which followed 24 employees and others were killed and 291 injured.

Work of the Tank Car Committee

One of the results of investigation of this accident was the appointment of a Committee on Tank Cars by the Master Car Builders' Association. This action was at the request of the American Railway Association and the committee was charged to investigate and report on the question of proper design and construction of tank car equipment for the safe transportation of volatile oils.

It was found that the tank cars were inadequate to meet safe transportation requirements and recommendations were made to require strengthening of those already in existence, safety valves for the relief of internal pressure and the adoption of new standards for future construction of this class of equipment.

In 1910 the recommended practice was adopted as standard and the committee relieved. The following year, 1911, a Tank Car Committee was again appointed to take up the question of the shipment of liquefied petroleum gas or casing-head gasoline in tank cars in co-operation with Colonel B. W. Dunn, Chief Inspector of the Bureau of Explosives. The year 1912 marked the development of the insulated tank car for liquefied petroleum gas and also for liquid chlorine gas.

Up to the time of the first appointment of the Tank Car Committee the principal products of the petroleum industry shipped in tank cars had been kerosene or illuminating oil and the lubricating oils. Gasoline was more or less a by-product of their manufacture and internal combustion motors had only fairly entered their stage of development for industrial and automobile use.

Hazards in Shipping Gasoline

A steady and rapidly increasing demand for gasoline as motor fuel has continued from that time until today the supply is inadequate from the refining of the greatest petroleum production in our history. To meet the increasing demand it has been found necessary to supplement the refining process by manufacturing gasoline by liquefying the gases from oil wells. This gives the product called liquefied petroleum gas or casing-head gasoline, which either alone or blended with heavier products is capable of causing and has caused

more damage and trouble than any other commodity ever shipped by rail.

Its dangerous nature is due to its great volatility or rapid evaporation and its vapors like those of ordinary refinery gasoline are so highly inflammable that they will ignite and flash back at great distances from their liquid source. Casing-head gasoline also has a very low boiling point and a high vapor tension or pressure which results from a rise in temperature. These hazardous qualities call for the tank cars in which it is shipped to be in perfect condition as non-leaking containers and also have provision for automatic relief of interior pressure which may develop in the tanks beyond a point which might strain them or cause them to rupture. This protection, which is very important, is afforded by safety valves.

The regulations and tank car specifications provide for tanks and valves to be kept in serviceable condition by periodical tests which have to be reported to the Chief Inspector of the Bureau of Explosives. Barring accidents or misuse it may be assumed if the stenciled dates which must appear on each tank show such tests to have been made within the prescribed time limits that the tanks and valves are in proper condition for service.

Rules Safeguard Movement of Tanks

Unless involved in such an emergency as a wreck, tank cars should not be in a condition to permit the escape of an inflammable liquid, and without such escape there is no hazard of fire. Yet reports reach the Bureau of Explosives daily of instances where leakage is found at seams, rivets, bottom outlets or through insecurely closed domes. A. R. A. rule 3, section (e) shows that such a car (empty or loaded) will not be accepted in interchange. These conditions indicate either that the car was offered to the railroad in that condition by the shipper, or that the leakage developed in transit. If the car was shipped in that condition, the initial carrier failed through its inspector to comply with paragraph 1822 (f) which prohibits its acceptance. If leakage developed in transit, the car should have been taken out of the train as soon as discovered and if the leakage could not be stopped, the contents of the tank should have been transferred into another. This action is called for in rule 2, section (b). In these operations or any other where there is an escape of inflammable liquid the principal thing to bear in mind is that lights and fires must be kept away.

This precaution is the most important of all and from various sources of ignition up to a distance of 480 ft. the records of the Bureau of Explosives show tank car fires to have been caused by locomotive sparks, hot coals, lighted matches, cigars, cigarettes, back firing of automobiles, oil or gasoline lanterns, torches, switch lights, fireboxes, steam cranes and other similar causes.

Handling Leaking Tank Cars

Without doubt the most serious situation to deal with is that resulting from wrecks and derailments. Tank cars then lose their contents through leakage caused by rupture of the shells or displacement of bottom outlet valves or it is necessary to transfer their lading into other cars before the wreckage can be cleared up. In nearly every case where leakage takes place through damage to the tanks there is an immediate ignition from the sparks and friction of grinding metal in the wreck. A leaking tank is a reservoir which feeds fuel to the flames and seldom if ever are means available to extinguish the fire until it has gotten beyond control. Water will spread instead of quenching it and if it cannot be smothered by the use of earth, steam or wet blankets, all efforts should be directed without delay to saving other property.

In wrecks involving tank cars which do not leak or where there may be leakage which does not ignite, the action of those handling the situation is most important. The first thing to do is to move away all lights or fires of every description and police the location with reliable guards to see that this precaution is strictly observed. Any leakage should then be stopped or reduced as much as possible. The next step is to dispose of the leaking liquid so it will not create a hazard. This is usually done by draining into holes in the ground and then covering the area with loose earth. While this may delay the handling of the wreck it must be remembered that there is no possible way of safely handling such wrecks while gasoline is freely leaking from tank cars or while a heavy leakage has not already been taken care of.

While gasoline is actually escaping all lights and fires should be kept at a distance, this distance being necessarily much greater on the leeward than the windward side. The vapor being heavier than air flows along the ground and settles in low places. It may travel a considerable distance with the wind, though when the air is quiet it will tend to form a layer along the ground. With the exception of closed electric lights all necessary signal lights and lanterns should be kept elevated and on the windward side. After allowing reasonable time for escape of vapor from the leakage and buried liquid, a steam crane may be brought up on the windward side, but not within a distance of 500 ft. The least injured cars should be first handled and if it appears that further leakage is to be expected such tanks should either be transferred or emptied into holes or trenches in the ground for burial.

Safe Methods for Transferring Contents

In transferring lading from wrecked or leaking cars several railroads are successfully using the air pressure method and the steam pump. Air pressure will not be practicable where there is any appreciable leakage from the tank, and on some lines it is thought that whether or not the tank is ruptured the steam pump is better. These methods are now under investigation by the Bureau of Explosives and a circular will soon be issued giving details of various types of such equipment which have been found to operate satisfactorily.

Up to this time the bureau has details of the successful use on one of the largest Eastern lines, of the single acting Blake pump by steam taken from cranes or locomotives. One wreck train is equipped with one of these pumps 7 in. by 5 in. by 10 in. and another train with one 8 in. by 5 in. by 12 in. At a point on the same line where movement of cars to be transferred is safe, they are hauled to an oil plant, and the lading is pumped into other cars by triplex No. 4 or No. 6 steam pumps after being drawn into a ground line. At two of its shops, this road also transfers by air pressure of 6 to 8 lb. per sq. in. through piping from the bottom outlet of one tank to the dome of the other.

A large Western line is using the Blake type of pump 6 in. by 4 in. by 6 in. as a part of its wrecking equipment with standard Westinghouse piping where it is possible and standard air brake couplings. Air from the train line of the wreck train is used to operate the pump.

Transferring by Air Pressure

Another road in the Northwest has used air pressure from the train line when tanks are not leaking. A substitute dome cover is placed in position, which is tapped through for two 2-in. pipe connections. One passes through to the bottom of the tank for the discharge and the other merely admits air into the dome. The discharge pipe has an extra joint for lengthening or shortening to fit the diameter of the tank. A rigid discharge pipe, however, will not completely empty a tank that is not plumb.

Several roads in the Midwest are using air pressure from the train line with a special dome cover and flexible non-collapsible hose for the discharge line. This arrangement by dropping the end of the discharge line into the lowest part of the tank will practically empty it of all its contents.

The general principle in regard to pumps for such use is that any pump which will operate on steam will also operate on air; and since these operations are to handle liquids under low head, any good type of steam pump having relatively large water cylinders and metallic valves should answer the purpose. In addition, since it should be portable so as to permit placement in various locations necessary for use, lightness is also essential.

With the air pressure method it will be understood that the safety valves on the tank will not permit use of more than 25 lb. per sq. inch, so no attempt should be made to exceed that amount. It has been demonstrated that pressure considerably lower will accomplish the necessary results. The special circular which I mentioned will be issued by the bureau at an early date and will give data covering various details of the required materials and assembly of apparatus together with rate of flow in transferring and approximate costs.

Other Dangerous Shipments

Other commodities with inflammable hazards such as alcohol, benzol, benzine, naphtha and carbon bisulphide are transported in tank cars as well as acids, sulphuric and mixed, which are highly corrosive and therefore classed as dangerous. Liquid chlorine gas and sulphur dioxide, both highly volatile and poisonous, are considered as especially dangerous because of this characteristic and require specially strong and insulated cars the tanks of which are entirely welded and built without the use of any rivets.

While these last mentioned liquids possess hazards peculiar to themselves, the handling of gasoline is by far the most important by reason of correspondingly greater hazards due to its greater volume of shipment. It is estimated that such shipments now move at the rate of more than 3,500,000,000 gallons annually.

From 1910 to the beginning of this year 117 people were killed on the railroads in the transportation of dangerous articles, other than explosives. Of this number 97 or about 83 per cent were killed by gasoline. Of 1,079 people injured, 684 or 63 per cent were injured by gasoline. Of the property loss amounting to $6,469,962 during those ten years, $3,215,922 or over 49 per cent was caused by gasoline.

Gasoline More Destructive Than Explosives

These statistics indicate that gasoline in disastrous results during transportation has shown itself to be many times as destructive as explosives and by a wide margin in point of hazard to life and property the most dangerous commodity from a railroad standpoint. The worst accident which has occurred in the transportation of explosives does not approach in effect the tank car disaster at Ardmore, Oklahoma, in 1915 when 47 persons were killed, 524 injured and property damage reached nearly $2,000,000.

In the face of this evidence of its terrible toll of life and property which has continued for years, the question naturally arises, "What is being done to prevent it?"

The Tank Car Committee with a membership composed principally of master car builders and selected as representing expert mechanical ability, has been faithful and untiring in its efforts to lay down requirements for the construction and maintenance of tank cars in the safest condition for such important service.

The Bureau of Explosives, with the advantages of research, investigations, the services of a skilled chemical staff and specially trained inspectors directed by a technical and mechanical expert, has had included in the regulations for safe transportation, rules which experience and a knowledge of dangerous products have shown necessary in proper preparation for shipment and safe handling in transit. These regulations have been supplemented from time to time by special circulars and bulletins, pointing out the lessons to be learned from failure to observe proper safety precautions and giving valuable suggestions and recommendations for suitable action to cope with various dangerous situations.

Notwithstanding all these measures, the loss of life and property continues. Some of it is unavoidable, as it has been truly said that as long as railroads are operated, wrecks will occur. Much is preventable, however, and the share of responsibility which falls upon the car foremen and their inspectors in line and interchange work is by no means light.

Weak Points of Tank Cars

The present types of bottom outlet, dome opening and safety valves are three weak points of tank cars. On account of the fact that records show the bottom discharge outlet responsible for 95 per cent of the leakages from tank cars, the chief inspector of the bureau last year recommended its elimination entirely. This would necessitate unloading through the dome and the suggestion was not favorably received by the oil industry and tank car owners. Their acknowledgment of the inadequacy of this outlet, however, was immediately shown in co-operative action through the American Petroleum Institute to develop a leak-proof valve and a subcommittee of the Tank Car Committee has also been active along the same line. Several types have been investigated and a number are now installed on tank cars for trial in actual service tests. Improvements in dome covers and safety valves are under investigation to develop types which will not permit the escape of vapor.

In addition to the precautions I have mentioned I would suggest the importance of impressing strongly these points in the minds of your inspectors. Remember always that the warning on the placard attached to a tank car loaded with an inflammable liquid means just what it says, "Keep lights and fires away." A leaking tank car of gasoline is a fire trap and if you pass one through on your inspection it may cause the death or injury of one of your fellow employees and others along the line. A loaded tank car is top heavy and if a side bearing is missing or the clearances are too great it may rock off the track and cause a serious wreck.

Bottom Outlet Requires Attention

If the outlet valve is defective or not closed the outlet chamber in cold weather is liable to burst from the freezing of water which settles from the gasoline and leaks into it, and if you discover such a condition by detecting a crack in the side of the nozzle, serious trouble will be avoided later by prompt arrangements to transfer the contents into another car.

If your work is where loaded tank cars are received from shippers, satisfy yourself that the cars are being loaded with the valve caps off. Then you will know that the outlet valve is closed and if the valve cap is lost or the outlet chamber broken off the contents will not leak out. If you have any doubt that shippers are loading without this precaution, arrange to have some of the valve caps removed occasionally before the cars are pulled out to see if the outlet valves are closed and in proper condition.

Examine the stenciled test dates for the tanks and safety valves and if you find either or both overdue, the car should not be forwarded under load. Rule 3, section "p" of the Interchange Code tells you that tank cars, the safety valves of which are due for test within 30 days, will not be accepted. Rule 16 provides that a road having in its possession a tank car due for test of safety valves must make such tests in accordance with the tank car specifications, billing the owner for the cost of same. Rule 9 provides for this and requires a certificate for such test to accompany the billing repair card.

Rule 2, section "b" states that "A leaky tank car shall have stenciled on it, in letters three inches in size, adjacent to the car number, the words 'Leaky tank. Do not load until repaired,' and the owner shall be immediately notified. Sten-

ciling must not be removed until the tank is repaired." This rule is designed to show the owner or user that a tank must be repaired before further use and will apply most often when transfers of lading are made in transit. Another important rule is No. 32 showing delivering companies responsible for missing dome covers and safety valves.

Proper Use of Placards

Remember that all tank cars loaded with inflammable liquids must bear two cards showing the proper classification name of contents and four "Inflammable" placards. If these markings are lacking do not pass the car until they are applied by the shipper or if they become lost in transit see that they are replaced before further movement. Rule 36 covers this and rule 107 provides for the charge for the service.

Any tank car containing liquefied petroleum gas or casing-head gasoline must also bear three white placards on the dome, two on the sides and one on the cover to warn against its removal while any interior pressure exists. Do not remove the dome cover of any such car unless absolutely necessary and this only in a location safe from the danger of lights and fires and after pressure has been removed by raising the safety valve. The boiling point of casing-head gasoline is low and any agitation of the tank will be very liable to cause the liquid to rise and overflow.

Precautions to Be Observed at Night

Never go up around the dome of a loaded tank at night with an ordinary lantern or torch. Use an electric flash light or an electric lantern. In approaching tank cars at night be constantly alert to detect the odor of possible leakage, remembering that the sense of smell if normally developed, is a good guide to warn of such hazards and the great danger is that of igniting the vapors rising from the leaking liquid.

Familiarize yourself with the specifications for tank cars and regulations and rules governing their proper physical condition and placarding. Obtain through the proper official of your line and read copies of bureau publications dealing with the hazards and proper handling of tank car shipments of dangerous articles, especially Circular B. C. L. No. 189, Handling of Wrecked and Leaking Tank Cars and B. E. Pamphlets Nos. 20-I and 20-J, Condensed Instructions for Wreck Crews and General Mechanical Superintendents, Chief Car Inspectors and Car Inspectors.

The prime object of your association and the practical aim of your personal vocation is to maintain equipment in the required serviceable condition for safe transportation. This is common to the purpose of the Bureau of Explosives, and we should all use our best endeavors to meet our share of these responsibilities for successful accomplishment of the greatest enterprise in the world, the operation of the American railroads.

President Gainey thanked Mr. Grant, on behalf of the association, and introduced J. O'Donnell of the Bureau of Explosives.

Address by Mr. O'Donnell

The interchange man is first confronted with a dangerous article by the placard on both sides and ends of the car, placed there before the car reaches the inspector. The method of manufacture of these dangerous commodities known as explosives and other dangerous articles, must be open to the representative of the common carrier or the Bureau of Explosives. The United States goes back to the very beginning and sees that it is made so that it will be safe to transport. Quite a lot of the most dangerous of all explosives are not allowed to be transported. For instance, nitro-glycerine and dynamite that contains more than 60 per cent nitro-glycerine, except in gelatine form, and in this form the type of package is specified and limited in weight so that each package can be handled practically by the effort of one man in an emergency. After doing that, if its shipment is to be presented in less than car load lots, there are certain labels designated for the dangerous articles other than explosives, alike in form and in marking. There is a tremendous safeguard in so doing because the freight handler knows them wherever he sees them, and so they are always alike. The labels are standard. The principal use of these labels is in warning the individual of a dangerous commodity; they also tell the kind of a placard to put on a car, for the car must be placarded.

One of the greatest problems that we had to deal with in the early days of this movement was the number of placards that were moving in transit. You can see that the fewer cards there were the greater the respect would be for them; that is why Rule 107 lays down a specific charge for removing cards that are unnecessary; also when placards are missing, a charge for applying.

The car load lots that you see moving are practically all loaded by the shipper, and he has to load according to a certain specified standard. The very bracing that he uses is specified. It must be no less effective than that laid down by the bureau for his guidance.

When the car arrives at interchange and you see the placard, a number of safeguards have already been taken, and the placard is there to warn you that you have a dangerous commodity in the car and you must handle it accordingly. You will also notice on the side of an explosive car that there are car certificates which state positively that the car passed a careful inspection; that it is a standard car of not less than 60,000 lb. capacity, and where possible it must have a steel underframe and friction draft gear. It must have no loose bolts. The roof must be sound, running gear in good condition, journal boxes packed in oil, and if there are draft bolts sticking through the floor they must be covered and beveled on the ends.

This car demands your most careful attention, and the rules laid down in interchange say you cannot offer such a car for transportation unless in proper condition. You cannot make any arrangements by which you can give that car to a connecting line if it is not in good condition. If it is discovered in bad condition on a receiving line, it cannot be moved back to you. That is a wise regulation because in a crowded terminal there is too great danger of shuffling these cars back and forth.

The interchange inspector is particularly interested in that car because he must go around it; see that from the outside it is in apparent good condition to travel; that the placards are on, and if there are any signs that the car has received rough treatment, he must open the car and inspect the lading. Some roads make a practice of opening all placarded cars on the receiving line; the regulations do not require that, but they do say if there is any apparent damage to the car, you must open it because the lading is of such a nature that you cannot afford to take any chances.

Another class of cars is that placarded "Inflammable." With explosives, unless there is a shock or friction, there is no danger of an explosion. But in approaching a car that is placarded "Inflammable" it is possible that it may be leaking, and bringing your lantern or lamp near, it will cause a fire from the inflammable vapors. So great care should be taken when you see an "Inflammable" placard. Above all things the warning on the inflammable placard should be strictly obeyed—never to bring lights or fires near that car, unless you know there is no leakage there.

Suppose you have a cut of cars moving on A road, transported to B road, standing on interchange, usually at night; it is dangerous for any inspector to take his lamp and begin to go down that cut of cars, not knowing but what some of the inflammable liquids may be pouring out and the wind

blowing that vapor towards the light. I have known of a case where the vapor has reached a fire 480 ft. away and flashed back.

The dominant idea when an inspector sees a placard should be that that placard is for a purpose and that purpose is a warning.

There are a few things I would like to say about tank cars. At St. Louis there are 1,250 tank cars placarded every day. The St. Louis plan is the ideal plan; that is, that every railroad company of any size that handles these tank cars ought to have a trained expert in the person of one of their inspectors whose particular duty it is to learn all he can about tank cars.

One of the best ideas I could leave with you who are in charge of men is to recommend that you take some man who you see is especially interested in this thing and encourage him—give him all the literature you can find on the subject, and when you have a leak or a wreck you will have a valuable asset in this man, who will detect danger at once if other men are careless.

There have been great improvements in tank cars. The head block is gone; the old patched sheet is gone; the old 40,000 lb. tank is nearly gone. The tank that had a shell like a patch of paper is gone. Now we have periodical tests. The 12 lb. valve is nearly obsolete. We have a 25 lb. safety valve, and in a little while we will have a bottom outlet valve, and we will have done a great deal.

I hope that what I have said to you will have some effect; that you will go home with a renewed idea that these regulations which you see for the safe transportation of explosives and other dangerous articles, as they appeal to the car men, will be renewed under your supervision; that the men will be given strict orders; that these are not railroad regulations; that they are Federal laws and must be obeyed. Some penalty is laid down, but we do not want to threaten a man with penalties, because a man who works under duress is not a good man. We want it done because it is the only safe way to do and because it is the law of our land. (Applause.)

Discussion

President Gainey: I want to thank Mr. O'Donnell for his instructive talk that he has given us this morning. I know that what he has said to you is from his heart.

Talking of examining cars on the outlet valve, a few years ago I knew of a case where a train was running along and the cap came off at the bottom and a whole tank of oil was lost. On examination it was found that the tank was loaded with the valve wide open, at a point where there was no inspector. In testing the cap it was found to have five threads and it did not tighten until it got to the last thread. The cap loosened and worked off. I think it would be well to take these caps off once in a while to see whether the valve on the inside of the car is closed.

E. H. Mattingley: As we have a representative here from practically every road in the United States and Canada, I would like to ask how many roads handling tank cars have supplied their inspectors and the men having to do with the handling of tanks, with an electric lantern as outlined by the speakers?

W. P. Elliott: I will say the St. Louis Terminal has.

A Member: The Pennsylvania has.

E. H. Mattingley: I would move that it be the sense of this body that we recommend to our superior officers that all railroads having to do with the interchange or handling of tank cars, supply their inspectors with a special electric lantern or flash light for the safe handling of such cars. (Seconded by W. P. Elliott.)

T. J. O'Donnell: While I fully agree with the motion, I am wondering if Mr. Mattingley realizes what a great expense that is. Wouldn't this motion be better. That every car inspector be advised by the yard department when a string of cars pulls in, of the initial and number of every car that carries explosives or inflammable matter; then he will know where the car is and when to look for it. I think Mr. Mattingley realizes that while our suggestion is a good one, it probably would not be adopted right away because you would have to delegate one man to do that work. In our terminal we have tank cars going through 37 yards. I would have to have special men at different points. We accept from industrial plants large numbers, and our superintendents have recommended that when a car leaves the terminal each division superintendent will have definite notice what position that car has in the train, so that when our men start on it, they will know right away when to look for it.

E. H. Mattingley: How would you handle that car at night?

T. J. O'Donnell: Odor would be the first definite notice. The inspector should be extremely careful not to go near when the odor is heavy. I have never had an accident of that kind in our district.

J. O'Donnell: It seems to me that the most prolific source of accident is the switchman's lamp. I believe every one of us should keep that before us. It cannot be said that with the inventive genius of today, something could not be gotten up to take the place of that device which has caused many fires in tank cars. There is no use having a man with an electric flash light going to one particular car when you may have an engine passing, or a switchman going down to the rear end of his train with a lamp. Wherever it is known that leakage takes place, we have got to use an electric flash light or wait until daylight. But I believe it would be a good thing if this body would go on record to some extent favoring a change in our plan of lamps for inspectors. I would oppose all inspectors having flash lights for the same reason that Mr. O'Donnell does, but I do say that we ought to have them.

T. S. Cheadle: I think it would be a good thing to have the class of the car stenciled on it. I understand that class 2 could be changed to another class; when it is loaded the man loading ought to be required to change the class of that tank.

E. H. Mattingley: The object I had in mind was that safety first should be and must be recognized, regardless of cost. If the fires which these gentlemen have described are caused, and will continue to be caused, by the open flame light, then, regardless of what it will cost to equip railroads, something of this kind should be prescribed for the inspection and handling of tank cars.

We all know as car men that it is the first duty of the car inspector to detect the trouble. If he finds a leaking tank he notifies the yardmaster, or the proper man in charge of the yard which is concerned, yet the only way he has of knowing the tank car is leaking is by the sense of smell. How many car inspectors will attempt to make repairs and carry a flame light by night while making these repairs? Therefore, in justice to our car inspectors and in harmony with the safety first movement, I would recommend that switchmen and car inspectors who have to do with the handling of tank cars and other cars containing inflammable liquids or explosives, be provided with an electric light, or some improved method.

W. P. Elliott: I believe if you would poll the railroad companies, you would find that they are doing that now. The inspector is the man who is notified nine times out of ten and he will take care of it. When he goes down, he has got to have something besides his lighted lantern. It isn't necessary that each individual inspector have an electric lamp if they are kept on hand so that the men who need them may use them.

E. H. Mattingley: I did not mean that the entire car inspection force should be equipped with an electric lantern, but possibly two to six lights, as may be deemed necessary, could be provided, according to the number of tank cars re-

ceived at that particular yard. I think the lights should be there, but I fear that is not the case in a great many of our large terminals at the present time.

A. Berg: These requirements are already met on our line and have been for a considerable time.

(The question was put upon the motion and the motion carried.)

G. Lynch: Mr. Grant's paper and the able address of Mr. O'Donnell were both very instructive, and I move you that a vote of thanks be extended to these gentlemen and that their remarks be incorporated in the minutes of our meeting. (Seconded and carried.)

President Gainey next introduced E. Arnold, general claim agent of the Grand Trunk.

Address of Mr. Arnold

As a Canadian who has lived half his life on the other side, I want to welcome you to Montreal. The railroad organizations have had some of their most successful meetings in this town, and the Canadians as a whole are very fond of their American cousins. We believe about the same as you do, and the Canadian lines have followed closely all of the rules of the American associations and have respected and upheld them all the way through.

I have been much interested in the remarks of the representatives of the Bureau of Explosives. We have had some very heavy claims on account of the transfer of oils from tank cars containing a high class oil to other tank cars that were not properly cleaned. I have seen several claims amounting to from $1,000 to $4,000 because the cars to which the oil was transferred were dirty, or contained inferior oil, and thus damaged the oil and made it unfit for the purpose for which it was intended. I do not know whether the car men are vitally interested in that, but they usually decide whether a car is fit for transfer or not.

Another thing which I brought up personally before the A. R. A. is whether we cannot get tank cars with the valve at the top instead of the bottom. If the valve breaks the car may leak for hours and the train men are unable to stop it; consequently oil of the value of from $2.00 to $4.00 a gallon is leaking along the entire right of way. With all of our American and Canadian inventive genius we ought to be able to invent a tank car without a valve at the bottom. In the large oil districts we have endeavored to have a change of that kind brought about.

The A. R. A. executives are much exercised at the present time on account of the large sums we are paying out in loss and damage. It is a subject that has been very close to me for a number of years and consequently I am very much interested in it.

I have a circular from J. E. Fairbanks, general secretary of the A. R. A., calling our attention to the large sums and asking us to get together and see what can be done. During 1919 the Class I roads alone paid out $104,000,000 during the year for loss and damage. A good deal of that was due to defective equipment, and I know during federal control and during the war we have not been able to keep our equipment up as it should be. In consequence there is a great deal of poor equipment going over the roads. Also, on account of the immense volume of business moving, we have not been able to pick out cars for certain commodities that require good cars, as we have in the past.

During federal control we did not examine the cars at interchange points as we did before. We did not take the seal records, and in consequence the sums paid for loss and damage were double.

We have recently been granted a large increase in rates, and it behooves us to give the public the service that they are paying for, and they are going to be more critical in the next year than before they paid the higher rate. They are going to expect us to give them good service.

The A. R. A. has ruled on defective equipment and said that the carrier supplying the car must make a proper inspection through a representative; must keep a book record of that inspection and must show that every time there is a claim presented for damages, and if they are not able to show that on loading the carrier will be charged with the full amount of the claim. Claims of that kind have been prorated on a through mileage basis, and it has been carried by all of the cars instead of the one that was very often at fault. Beginning September 1, unless we have a book record, we have got to pay the claim if we use a defective car. So it behooves us to give proper inspection in that respect.

There are a great many hopper bottom cars loaded with coal leaving the mines that are in unfit condition, and a car has to carry the coal to its destination. I would like to emphasize the importance of close inspection at the coal mines. There is a cry for coal all over the continent as there never was before, but I think we can get better repairs to some of these cars than at the present time.

Since 1893 our average claims have increased from $30 to $55. The courts all the time are ruling in favor of claimants. Up to a few months ago we paid claims on the basis of invoice value at the place and time of shipment. We would make a man show his invoice, but now the courts have ruled that we have got to pay the claim on the basis of the value of the goods to destination of consignee. It has made a wonderful increase in our claim payments because we are not able to determine the value of goods at destination.

We have many cases where refrigerator cars containing fruit and other things of that kind are run over several different roads. The drip pipes are supposed to be clear. They are iced and when they get to destination, from the Pacific to the Atlantic, we frequently find that the drip pipes are clogged and the car will have a foot or two feet of water, the doors are open, and we have a claim to pay. Refrigerator cars are largely privately owned cars. Get better inspection to protect your own road and to protect your connection.

We have the same trouble in connection with the bunkers and different parts. Many of the employees did not know what the different parts of the refrigerator cars were and were not able to carry out the instructions. Now we have a monthly meeting and we have been instructing all employees and examining them as to their knowledge of the car, just as they are being examined for safety and other appliances.

The Grand Trunk has had in operation for some time a claims prevention campaign, and the results have exceeded our most sanguine expectations. Without going into details or quoting figures extensively, I would say that broadly speaking our claim payments due to defects in service of one kind and another have decreased by 50 per cent.

I mean of course a decrease as compared with the earned revenue. The actual amount would be more in our favor were it not for the fact that the high cost of the commodities operates against us. To achieve this result required the cooperation not only of our own staff, but also the staffs of other lines. The benefit of better methods of handling freight which will accrue to any one particular road as a result of their own endeavors will be negligible if other roads are not moving in the same direction. The great bulk of traffic moves in car load lots, and it will be easily seen that handling with the utmost care over portion of the route will be practically of no use if the car is negligently handled on the balance of the journey. The damage in evidence at destination will be what is known as "unlocated damage" and the claim if paid will be prorated on a mileage basis so that the careful carrier pays a prorata amount equally with the careless one.

This condition cannot be overcome. The remedy is for employees to handle cars as if their own company only was involved and they were individually responsible for the arrival of the shipment at destination in good shape.

In the proper apportionment of claims paid as between car-

riers the members of your association play a very important part. Especially is this the case in losses from open equipment. When loss has been established and the claim paid, the next question is whether the loss is a located one or an unlocated one. This gives rise to the query, "How did car check at the junction point?" The answer to that question will depend to a great extent on the thoroughness with which the inspector carried out his duties or rather to what extent he carried the inspection.

The principal losses from open car equipment are coal shortages and parts of machinery. As regards the latter, unless in very exceptional cases, a junction examination will scarcely be sufficiently minute to say with certainty whether loss occurred or not. Such shipments are usually described as a carload of machinery and the parts can be and frequently are removed in transit without anyone being the wiser till check is made by consignee when it is found parts are missing. These cases rarely present any difficulty, it being pretty generally agreed by all having any connection with the adjustment of claims that such losses are unlocated and where settlement must be made as a result of suit or otherwise such claims are usually prorated from shipping point to destination.

In the case of coal shortages, however, a different situation presents itself. Here we have a case where the whole matter is in the hands of the railroad employees. The car is scaled and a certificate furnished to the mine owner giving details of gross, tare and net weights. The car arrives at destination, the consignee is advised of arrival and demands the car be weighed before he accepts it. He gives as his reason for this demand that a previous car accepted by him in apparent good order was ten tons short. On weighing this car a similar shortage is discovered and the carrier delivering the car is presented with a claim for the value of the shortage. In fact various firms refuse to accept cars of coal till weighed and rely on weights so obtained to press claims for loss.

Such claims must be recognized as the legal departments of various roads have ruled unless it can be proven conclusively all the coal loaded at shipping point was delivered at destination, less allowances if any covered by tariff, carriers are liable. Where shortages of quantities up to say five tons occur in transit either as the result of robbery or rough handling causing part of the contents to fall off the car, or of leakage developing in transit and being stopped without record being made on the waybill it will be conceded without question such losses would not be noted in junction inspection.

The number of heavy claims covering shortages of coal principally from Pennsylvania points to destinations in Ontario induced this company to give special attention to the examination of cars received at Niagara Falls during the months of July and August 1920. As a result our records covering the 30 day period ending August 19 gave the following results:

From the L. V. we received 32 cars in which shortage existed of 176 tons. From the N. Y. C., 35 cars in which shortage existed of 170 tons. From the Erie, 9 cars in which shortage existed of 27 tons. A total of 76 cars representing 373 tons short.

Figuring the value of this coal conservatively at $14.00 per ton the loss represented $5,222.00 during one month.

We also receive coal from the D. & H. at Rouses Point. During 1919 shortages were noted for the entire year totalling 1,795 tons. Commencing Jan. 1, 1920, a more rigid inspection was put in force and the figures covering eight months since installing this new method shows a shortage detected of 3,753 tons. To obtain the best possible results from junction inspection we are convinced it is imperative that where any depression is noted in the load or where any evidence of leakage is evident the car or cars should be weighed as it is impossible for any examiner to give a reasonably safe estimate of the quantity missing. In fact we have had cases of shortage where the junction record showed overhead inspection made and no exceptions noted to either car or contents, yet a heavy shortage was disclosed as a result of weighing out at destination. As a result of direct enquiry to operating officials of the carrier on whose rails car originated we found the quantity claimed for, over 15 tons, was removed on their rails.

Cases of this kind of course are rare and the only inference to be derived from their occurring occasionally is that the party entrusted with the duty of inspecting cars did not in fact inspect them but merely made a book record to the effect everything was O. K.

These remarks are made not in any spirit of carping criticism but are offered in the broad spirit of betterment of the service. If they succeed in eliciting from this assembly suggestions tending to improve the claims situation or promote closer co-operation between the car inspectors and car foremen of the various roads at interest their purpose will have been achieved.

I am glad as a claim representative to meet you gentlemen. I want to say in closing that on Oriental oils we have had serious loss, and have considered the matter of preventing this loss to a large extent, but we do not seem to be getting anywhere. This oil comes in wooden barrels and in summer it seems to thin and leak. We are trying to classify it so that these cars should be iced during the summer. The shippers fought us so that we got the Interstate Commerce Commission interested.

President Gainey: I want to thank Mr. Arnold for his very instructive talk, which will be incorporated in our minutes.

W. P. Elliott: Why would oil be put in a different kind of car? The way bill would tell what that car carried previously.

E. Arnold: What I meant was, when you have to transfer a car of oil that is worth two or three dollars a gallon, try to get the same kind of a tank, and a car that is fit to hold it. On grain leakage last year the Grand Trunk paid $128,360. There were a great many cars used that were unfit for grain. Our claims have been reduced 50 per cent the present year over 1919, notwithstanding the heavy increase in the cost of all commodities, due to the efforts of the claim prevention committee.

T. J. O'Donnell: The losses that Mr. Arnold mentions are largely due to defective hoppers. For the past five years we not only used brown paper but we used logs to keep the coal in the cars. Out of 50 cars that were delivered there were 25 fixed up with boards and stakes to hold the coal in. We cannot transfer every car that is defective. The Grand Trunk goes the limit in fixing them up. We have inaugurated an inspection in the receiving yard by a Grand Trunk man. Our car inspectors in addition to the mechanical inspection, when they are up on the end of a car to look for brake appliances, must see if there is any depression of the load. They note the depth and take a record. While I would rather see the agent do it, the car man can do it with little or no delay. It ought to be done where open top equipment is used so extensively.

I want to introduce Mr. James Coleman, who is now assistant superintendent of motive power of the Grand Trunk.

Address of Mr. Coleman

I did not expect to be called upon to say anything to you today. I came here to listen and not to be heard, and I have been very enthusiastic over what I have heard here this morning. I believe this is a school of troubles in the car department. You are starting here a campaign to show to the railroads the shortcomings in the handling of their equipment,

also in the design and construction. It is true that the equipment has not been taken care of. The railways have not had an opportunity, but if the men in charge of the departments of the railroads could only sit in here this morning and listen to the intelligent criticism, and the defects that have been brought out by you this morning, it would be an education. I want to say to you frankly that the proceedings of your meetings, if they have all been on the same strain of this one here this morning, do not get publicity enough. It does not reach the heads of the departments. You men here know more about the defects and the reasons for them than the man who sits at a desk in an office and designs the equipment and tells you how to operate it. You will find the defects.

If a man in the car department wants to find the shortcomings of some particular design of a car, who does he go to? The car inspector. He is the man who finds the defects; he is the man who knows; he is the man the railroad pays to know, and if he did not qualify he would not hold the job.

I am going to advocate, all I possibly can, more publicity for your proceedings where they will reach the men who are responsible for the maintenance of the equipment, for the good criticism that you offer here will be an education to them, as I have stated before. I am glad to welcome you here and hope you will return to Montreal next year.

President Gainey: I am sure we all appreciate the very kind words of Mr. Coleman.

W. R. McMunn: All the gentlemen who have favored us with their presence have been thanked before, but I would like to suggest that the association extend to them a rising vote of thanks, to show that we appreciate their coming. (Carried unanimously.)

Thereupon the meeting adjourned.

Wednesday Afternoon Session

At the opening of the afternoon meeting M. J. O'Connor presented a paper on the Lubrication of Freight Equipment, with regard to obtaining maximum mileage and methods to be pursued to overcome hot box trouble. This paper, with the discussion will be published in the January issue.

REPAIRING CARS IN TRAIN YARDS

BY O. E. SITTERLY
Foreman Car Inspector, Pennsylvania System

I have been requested by our secretary to open a discussion on the best means of repairing cars in train yard for defects that can so be repaired to overcome setting cars on the repair track, especially loaded with high class freight such as meat, iced commodities, poultry and similar shipments.

I personally believe that there is no one present who has not the same subject in mind, knowing the real necessity of cutting down so many cars being crippled, which have to be switched out of trains and moved to repair tracks, and bearing in mind the serious delay to shipments, the liability of claims and the extraordinary expense in so handling.

We, as supervisors, have been hiding behind the transportation department and using this as a defense, claiming that the holding up of trains to make repairs in transportation yards is causing serious delay. However, my inquiries, as well as our practice on the Pennsylvania, have proved beyond a doubt that the delay in holding cars in outside yards for making repairs has overcome considerably the delay and expense of switching cars into shops, and we find that the transportation people are co-operating with us in our efforts to cut down the shopping of all classes of cars.

It has been so arranged that on our inbound trains the yardmaster will allow us to work on trains until such time as they are ready to handle the cars, thereby we have increased the number of cars repaired in the outside yard, which, as you can readily see, has decreased the number of crippled cars, delays and amount of expense in handling the cars to our shop tracks.

For your information, I am particularly referring to repairs such as brake beams, ladder treads, hand holds, adjustment of lading at doorway, applying journal bearings, etc.

I have every reason to believe that this discussion will bring out some very interesting information. Also I believe that during this discussion facts will be brought out or some recommendations made that will help us all to go back home and start a campaign in such a manner that it will be a surprise to our officials to note the large number of cars that are being repaired in the outside yards, thereby cutting down the shopping and holding up of so many cars.

It is a surprise to note the defects that cars are being shopped for at the present time. This is due to the lack of sufficient help in the outside yard. This also should be looked into with a view of reducing delays in making these repairs.

My experience in the outside yard for the past 22 years has proven to me, beyond a doubt, that there is considerable room for improvements along these lines, and I know that we have the timber amongst us today that can do considerable to help this along.

Discussion

W. P. Elliott: We do nothing in train yards except safety appliance repairs that can be made without the men going under the cars.

T. S. Cheadle: We have a man who makes repairs on perishable trains, as has been brought out in the paper. The practice is to put up a flag on the end of the train when the inspector makes his inspection and checks defects, and makes the repairs. At our Potomac yards we have a man who does not do any inspecting but passes on inspection, and makes the original record of repairs. At either yard we have a man who makes the repairs and the original record himself, and turns it in to the general car foreman to be made out on the A. R. A. billing repair card.

Mr. Smith: We have several places where we receive cars in the yard, and the inspector is not exempt from making repairs. He has to make a certain number of repairs, and then behind him comes the repair man who will make heavier repairs, such as cutting off a handhold or putting on a brakebeam. We have two men working together who follow up on heavy work. We do not exempt the inspector from making light repairs. We lock the track in addition to putting up a blue flag.

W. P. Elliott: How many follow the same practice of having inspectors make light repairs? Under the national agreement all of these men are classed as car men. The inspectors have claimed in some districts that they maintain the classification of car inspector if they do not have to make repairs. We say the car men are only entitled to the distinction that he is assigned to. It does not relieve him from any work that he is assigned to do. Do you ask car inspectors to make light repairs?

President Gainey: We ask all of our inspectors to make repairs. Three or four months ago I was at one point on our road and that subject came up, whether a car inspector had to do the work and their own inspecting. The sentiment on our system was at that point that they did. While their classification on the pay roll was inspector, it is done so that the man at the head of the department will know where his men are, but he says "A car man is a car man, no matter where he is put; if he hasn't got repairing to do he must help out with the inspecting and vice versa." That is what we are following out.

T. S. Cheadle: We are carrying that on now without any exceptions being taken to it.

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W. P. Elliott: Our men say they are not supposed to do it. I maintain that a car man is a car man. If it is a question of doing autogenous welding, or something like that, it is different.

President Gainey: We take two inspectors, one light repair man and one oiler to go over a train; two inspectors go over the train and a light repair man follows. If an inspector gets to the end of the cut, he doubles back and makes the repairs until he meets the light repair man.

T. J. O'Donnell: I believe that we are overcoming the switching of light repair cars to the repair track. We have six or eight meat trains between midnight and morning. You all know what it means if you cut out five or six cars to the repair track. The D. L. & W. will hold a train while they are going through and oiling and repairing at East Buffalo. They have five or six follow-up yard repairers. I maintain that two or three men following up the inspectors on a meat train is an excellent practice, because if a meat car is set out to a repair track it not only loses the train, but the next train is 12 hours away, and when you hold it that long it means 26 or 28 hours in the terminal, because the operating department cannot handle it, and the result is that we get a claim.

R. Barnaby (D. L. & W.): In East Buffalo we have two air inspectors and two followers-up and an oiler on a train. After a train is completed by the yard department we lock both ends of the switch with a blue flag on each end. On live poultry or meat cars we apply brake shoes in the train and do all that class of work. We generally use 40 minutes or an hour on a train of 45 to 50 cars. We do everything we possibly can to keep these cars in transit.

W. P. Elliott: I believe that is the practice pretty generally to put the flag at both ends. We get a certain amount of time not only on live stock trains but on dead freight.

A. Berg: I think it is general throughout the country. I know it is mandatory with many of the railroads. We will tolerate a fellow remaining idle a few hours rather than tie up a train.

President Gainey: In some yards you cannot do that where you have 25 or 30 tracks and they are continuously switching and classifying. You can even put draft bolts in if it is an empty train.

T. J. O'Donnell: We put draft bolts in a hog train.

W. P. Elliott: You can do a lot of that work by co-operating with the yard department. In classification it is different, and if you have a car going to the repair track, it doesn't make any difference. You cannot do work on that class of trains. It is out of the question.

T. S. Cheadle: The freight houses in our territory are taken care of the same way. They have one or more men to look after the light repairs. These men are inspector and repairer and classed as such.

A Member: What is the general practice of having the material on hand for making the light repairs, and what is followed out in most yards from a safety standpoint?

T. S. Cheadle: We have a pen that we put the material in. If they have to have a brakebeam they go get one. The men go every day and fill up the pen with the pieces that are lacking in the stock that is put there. Provision is made that this can be charged out to train yard repairs.

President Gainey: In a great many yards the material is kept in about the center of the yard or some in the center and some at both ends where the men can get it readily.

A Member: At West Albany, on air brake inspection on the receiving track where there is one movement one way and another movement the other way, and also classification in the yard, we have a difficult problem. At one time we tried to test our trains on the receiving track with the engineer's valve. It was surprising to see the number of defective brakes found on the trains on receipt. We try to put in cylinder gaskets, test the triple valves and change triple valves, and get the trains in pretty good condition on the receiving track. We had quite a big yard and found there were so many defective brakes and it delayed cars so long that we had to stop it. We tried carding and found that we needed a shop track of 5,000 cars to make the percentage and bring it up to the required 85 and over.

We have what is known as hand brake tests; one man working on top and two on the ground. These men are followed by running repair men. We have had 10 or 15 brake cylinders to take down in a train of 65 cars. I wonder if anybody else is doing that or what their method is.

R. Barnaby: We have three men on each shift. They change triples and clean cylinders on all trains after the trains are made up.

Mr. Smith: We do not do any of the work of adjusting and cleaning brakes in the receiving yard. The cars are repaired there except the brakes, and they are humped over into the classified yard. They have enough men down there and do not call the crew until they know the train is ready. All trains are made up and called one hour before they go. It does not mean that we could only despatch one train an hour; you would have to have two or three gangs, the train would be ready an hour before being called to leave.

T. S. Cheadle: I think we should all read the discussion on this by the Air Brake Association and do the best we can with it.

F. W. Trapnell: I move that the paper be received and spread upon our minutes, and a vote of thanks extended to the man who wrote it and to Mr. Barnaby who read it. (Seconded and carried.)

T. J. O'Donnell: I am going to appeal to all our members to try to get more new members. I asked Mr. Keene at noon how many he had and he said about 40. We came up here with the firm idea that we could get 150. If you brush up against anybody who is not a member, I think we ought to get after them.

Thursday Morning Session

As soon as President Gainey called the meeting to order the discussion of the selection of the place for the next convention was taken up.

T. J. O'Donnell: I really think the time has arrived when we ought to consider one central city as the meeting place of this association. We have practically covered the section east of the Mississippi River, and I would like to have our Executive Committee consider the city of Chicago as the meeting place of our association in the future.

W. J. Stoll: That city has been my choice not only now but in the past. I think Chicago should be made a permanent meeting place on account of hotel accommodations there as well as trains. The Sherman Hotel is equipped with air and electricity for power that the supply men may use for running machinery if they want to, and it would increase our membership perhaps 100 per cent.

F. W. Trapnell: I think the proper method would be to read the invitations. When I was president I favored one meeting place.

President Gainey: I am in favor of a regular meeting place, and I would like to see the members of this association this morning vote to make Chicago our permanent meeting place and let the Executive Committee set the dates of meeting. The by-laws should be changed so that one meeting place could be designated.

F. W. Trapnell: You cannot change the by-laws now.

W. J. Stoll: I believe the Executive Committee should have full power to act.

Wm. P. Elliott: I do not believe it is right to give the Executive Committee full power. They assumed power last year that did not belong to them.

T. J. O'Donnell: I move you that this assemblage recommend that this convention has come to the conclusion

that it would be for our best interests that all future gatherings of this body be held in one central city, and that the association, knowing the location and convenience, select the city of Chicago for our meetings in the future and that arrangements be made accordingly by our Executive Committee. (Seconded.)

J. C. Keene: We have a small attendance here this morning, and I think it would be well to let the Executive Committee decide.

T. S. Cheadle: It seems to me it would be no more than right to put that up to the members now.

(The question was put upon the motion and carried.)

Two papers on A. R. A. billing were then presented.

REPORT OF COMMITTEE ON A. R. A. BILLING

In order to provide the most essential requirements for A. R. A. billing, the building up of an efficient force of car inspectors and repairmen is necessary. The duties of these are to report work on cars under A. R. A. rules. The shop force, such as car foremen, car inspectors and repairmen, is the only foundation from which an efficient organization can be built, and when properly coached by some one in intimate touch with all phases of the work, the billing department will be one of the best and most efficient departments in the railroad service.

The fact that should be impressed on the shop men as well as the A. R. A. clerks is that every item of repairs should be shown on the original record, and all items should be thoroughly checked against the work performed, to see that no repairs are shown on the original record that were not actually made. This will ensure foreign lines being billed only for work actually performed, and will also ensure the handling road being reimbursed for its work.

There was, during federal control, more or less disorganization of the A. R. A. forces, which had been built up by years of training men for this class of work, and I doubt if there is a railroad in this country that is getting the efficiency they should get in the A. R. A. billing department at present. This condition results in a considerable amount of incorrect billing and causes a large amount of controversy and needless correspondence, which an efficient organization will avoid.

In our experience we have found the average shopman ready and willing to learn when an opportunity was afforded him, but, unless the importance of keeping in close touch with the rules and various changes from year to year is occasionally brought to his attention, he is liable to overlook some very important item.

The first thing that should be done when an inspector, car repairer or A. R. A. clerk is put to work, is to give him an A. R. A. book of rules to be studied. His superior should discuss the rules with him thoroughly until he is satisfied that the man is familiar not only with the rules, but that he understands their interpretation and application correctly. The A. R. A. clerk should visit the repair tracks, where the original record is compiled, as often as conditions will permit, and check the work on the car with this record, so that he may have an opportunity to familiarize himself with the work and various kinds of material used in making repairs to cars. This will enable him to check more closely the original record as turned in by the repairmen, and detect errors that might otherwise be written into the repair cards, causing them to be returned for correction, resulting in unnecessary work and delay.

For instance, if a repairman in applying a pair of steel wheels to a car would through lack of familiarity with correct billing practice fail to report the amount of service metal on wheels removed and applied, the clerk handling the repair card for the same reason would write up the repair card, leaving this information off, and forward the card to the billing department which would have to return it for proper information, with the result that the car having gone back into service and the wheels removed disposed of, any report made would necessarily be fictitious.

Also in applying journal brasses, if the box location were omitted and the following information not given on the original record:

Coupler applied, not showing whether key or yoke attachment or size: also if A. R. A. type *D* applied not shown.

Number of brake beam removed or applied.

When applying center sill or center sill splices, showing all bolts and other items necessary to complete the work: also if center sills are spliced, whether first application of splice boards, so that all bolts used will be charged at gross weight.

In applying one draft timber, if draft bolts were used other than were used in the draft timber applied, and were just shown as draft bolts, not showing how many were used in the opposite timber, would result in incorrect information.

We have just cited a few of the many, almost thousands, of discrepancies with which we have to deal almost daily.

Every effort should be made to have these reports accurate, as to fall into the practice of estimating is bound to result in fictitious information, and tends to create the impression that correct and accurate reports are not necessary, and would have the effect of introducing carelessness and indifference into clerical work, as well as loss of interest at the shops.

The report is signed by J. A. Roberts (C. & O.), chairman, and Allen Foster (N. Y. C.).

INDIVIDUAL PAPER ON A. R. A. BILLING

BY C. C. STONE
Southern Railway

The subject of the preparation of original record, billing repair cards and A. R. A. bills, is a big and important one in which all carmen are vitally interested, in that it is the only item or resource from which the motive power department of the railroads may secure a credit to their accounts and thereby reduce operating expenses, which the officials are so often called upon to explain.

The matter of records is of vast importance in supporting charges for repairs. The rules require that the original record, whether in loose leaf, card board or book form, be complete and that no information be assumed. The Arbitration Committee has always based its decisions on the records, and the A. R. A. Section III—Mechanical has gone far in the past few years in adopting standard forms with a view to obtaining uniform records in all railroads. The average mechanical man who repairs cars and also takes record of same, more or less depreciate records, and we feel that their importance should be impressed upon all concerned for the preparation of billing repair cards and A. R. A. bills, keeping in mind the principle of honesty advocated by the American Railway Association and the necessity to show the true condition at all times.

The A. R. A. rules require that billing repair cards must check with the original record of repairs, as regards the detail of charges, and that the common terms bent, broken, and missing, if used when caused by derailment, cornering or sideswiping or other causes shown in Rule 32, must qualify to show such cause, as authority for endorsing billing repair cards "No Bill."

The rules require that a billing repair card must be furnished the car owner for any repairs made to all cars. The average car department employee is under the impression that when repairs are made to a foreign car that will not be properly chargeable to the car owner, no billing repair card is to be furnished the car owner; this is entirely wrong, for the car owner desires to know at all times the repairs made and whether the repairs are proper or improper.

The preparation of original records, billing repair cards and A. R. A. bills, which involves a mass of detail work.

is largely a routine matter and we feel that the most important factor is the preparation of billing repair cards, the foundation on which the A. R. A. bills are rendered.

The car department employee should learn to term the material used in making repairs, as they are termed in the A. R. A. rules, for the benefit of employees who are not practical car repairers, whose duties are the preparation of billing repair cards.

A good deal of trouble is being experienced in not giving correct car initials, numbers and dates.

The A. R. A. rules stipulate the charges to be made for nearly all items of repairs to cars, and I would suggest to those making up billing repair cards and A. R. A. bills, that if they will keep before them the spirit or intentions of the A. R. A. rules in applying the labor charges shown in Rule 107, and which spirit or intention is shown all through the rule, it would greatly assist in eliminating if not practically doing away with the difference of opinion as to the proper method of applying such labor charges.

For this reason we wish to call your attention to the importance of an efficient organization in the car department; and to point out the duties of each as relating to this work and to show the necessity of systematic instructions in keeping all concerned thoroughly acquainted with the rules at all times.

We believe that meetings should be held upon receipt of a new rule book each year, also on receipt of supplements received from time to time, and that free exchange of views, where matters are argued from all points, is the most efficient manner in which matters of importance can be impressed upon the minds of those concerned, with a view of establishing a uniform understanding of the A. R. A. rules.

The position of car foreman is one of the most important in the operating department, and requires a man of sound judgment. He is required to repair equipment of all classes and design and maintain standards without blue print instructions. He is responsible for inspection in interchange and transportation yards and is required to pass judgment on the safety of equipment and in fact he is the versatile man of the railroad to whom all operating officials turn when anything special is anticipated. Car foremen should be thoroughly acquainted with the A. R. A. rules of interchange and billing that they will be familiar with the actual value of labor and material and thus protect the financial interests of the railroad company by which they are employed.

The position of A. R. A. billing clerk is very valuable in assisting the car foreman. The clerks should be picked from the car repair force when available, they should have a fair education and write a legible hand, and with the practical knowledge of construction of cars the task of the application of the A. R. A. rules will be much easier in the preparation of billing repair cards.

With the interchange inspector rests the responsibility of protecting the railroad company from receiving equipment with handling line defects, to see that standards are maintained, and that cars are in a safe and serviceable condition, and that no safety appliance defects exist, as required by law, and that all handling line defects are properly carded. Many interchange inspectors are located at insolated places and unless some special efforts are made to keep them posted in the application of the A. R. A. rules, they will naturally feel that their positions are of little importance and become lax. Keep the inspectors enthusiastic by calling on them occasionally, impress upon them the importance of keeping records in protecting the company's financial interests, subject them to periodical examination on the A. R. A. rules and their ability to determine proper names of various defects. Special attention should be called to the importance of showing all necessary information required by the A. R. A. rules for repairs made, on the original record and billing repair cards.

Special attention of car inspectors is called to the importance of closely inspecting all cars received from foreign lines and of requiring defect cards for all "cardable" defects discovered. It is also important that special attention be given to inspection of all cars for safety appliance penalty defects.

It not infrequently happens that an inspector, not being familiar with the A. R. A. rules, will place a defect card on a foreign car to cover an owner's defect. This is a serious mistake because under the A. R. A. rules the issuance of such a card under such circumstances makes the line issuing the card responsible for labor and material, whereas, if the card were not issued, the owner would be responsible. Great care should therefore be used by inspectors in issuing defect cards to prevent errors of this kind.

It also happens that some interchange inspectors will receive a foreign car with a handling line defect, and run the car on book record, not taking in consideration that the same car when offered at some other interchange point on the line of road will have the defects carded, thus penalizing the handling line for not having car properly carded when received at some other interchange.

Remember that a defect card is authority to bill for labor and material necessary to complete the items shown thereon and is a check against the railroad issuing same.

Defect cards should specify that all damage occurred to *A* or *B* end, right or left side, which will give bill clerk a fair conception of the damages and enable him to check overlapping labor.

The successful rendition of A. R. A. bills also requires an efficient organization thoroughly familiar with the A. R. A. rules, interpretations and arbitration decisions and in view of the importance of this work, in that they are handling the equivalent to cash money, special attention should be given to the training of bill checkers.

To successfully price billing repair cards, it is necessary that bill clerks secure a general knowledge of the physical construction of cars, which can only be obtained by practical experience or observation.

Clerks whose duties are the preparation of billing repair cards, located at or near repair tracks, who have not had practical experience, should take every opportunity to avail themselves of the physical construction of cars from observation, thus enabling them to properly prepare billing repair cards.

The handling of A. R. A. bills on the Southern Railway System is a joint arrangement between the motive power and auditing department. The motive power forces prepare the billing repair cards as to repairs made and reason for same, showing kind of material, weight of material and labor hours, the auditing force, checks the weights, labor hours, inserts all net charges and totals up repair cards, seeing that all information as required by the A. R. A. is properly shown. These repair cards are forwarded from the master mechanic's office to the auditor of disbursements' office weekly on form 1043, showing the number of repair cards forwarded. After record has been made of repair cards received, they are then passed to bill checkers for pricing. Any repair cards not properly prepared are returned to the originating station, with a notation pointing out the additional information required and calling attention to the specific rule which governs. After pricing, the repair cards are assorted as to owners and passed to the bill writers. For writing bills we use billing machines.

The auditing forces also check and voucher foreign bills; the checking is done by separate forces, one force checks and prepares bills against foreign railroads, and the other checks foreign railroad bills against the Southern Railway System. The forces are continually comparing charges, all disagreements are decided by the chief A. R. A. clerk.

The accounting department has a force of special traveling auditors, assigned to A. R. A. work. They are to visit all

shops and inspection points and confer with officers and employees having to do with making repairs to cars, and issuance of A. R. A. billing repair cards, defect cards, and trainmen's report of repairs made. Special attention is given by them to explaining and interpreting the practical application of A. R. A. rules to work done by car inspectors, and others. All officers and employees are earnestly requested to give them their hearty co-operation and support.

Their duties are both instructive and constructive, instructive in that they are required to teach the A.R.A. clerks, inspectors and repairmen the fine points of the work and explain the application of A. R. A. rules in billing, constructive in that they are required to suggest changes in methods or organization to best safeguard the company's interest.

Supplement No. 3, effective Sept. 1, 1920, on account of changes in labor hours and net material charges, and additional items, requires careful study to properly prepare billing repair cards and A. R. A. bills.

Discussion

On motion the reports were received and ordered spread upon the minutes of the association.

T. J. O'Donnell: One thought occurs to me and that is that the heavy responsibility that falls upon these accounting clerks would justify a change in their title. They should be classed as shop inspectors, or shop accountants. The word "clerk" does not appeal to me. I think also there should be an outside man working in harmony with the general foreman.

W. R. Morris (A. B. & A.): I have exclusive charge of A. R. A. billing repair cards. The greatest fault among inspectors is the different names we have given parts of repairs. If they would adhere to the rule in writing up the repairs, it would save much trouble. Some fellow will write spring bolster by three or four different names, and a lot of them are not familiar with the proper terms. I stayed five years on the repair track before I went in the office. In the past two weeks before I came to the convention I checked $35,000 worth of bills against us. I found technical errors due to the inspector or foreman not showing conductors putting in brass and air hose. I did not write a letter because the system used on our line is to furnish all points and train crews with new brass and air hose. If the man fails to put this in, one man cannot handle it.

As for the bill clerks, I would like to have the gentlemen here go into that and tell them not to take exceptions to technical errors such as new air hose and brass applied. We are using a re-filled or re-lining brass and standard air hose and I would like to ask each of the foremen here to ask their bill clerks personally, when they take exceptions to a bill, to know that they are right and not take exceptions to a technical error that some bill clerk has overlooked.

T. S. Cheadle: It seems to me that we get the highest efficiency in this work and we should have a technical understanding of terms. It is very tedious for bill clerks. The same thing is true of sheathing on ends; on sides it is siding.

The committee appointed to consider the maintenance of passenger cars did not submit a report, but an individual paper prepared by the chairman, J. R. Schrader, was read by C. S. Adams.

PASSENGER CAR MAINTENANCE

BY J. R. SCHRADER
District General Car Foreman, New York Central

This is a very broad subject and one which requires considerable attention. After equipment is received from manufacturer, or after general shopping, it should be, and generally is, in first class condition. Therefore, it is important, in order to maintain this equipment in first class condition, that it receive careful inspection at each terminal and that all necessary repairs are made. If small defects are not repaired it may not be long before the car has to be cut out of service and shopped.

In order to obtain the best results there should be a system enforced at points where this class of work is done. The condition existing at each point, of course, has to govern the organization of such a system. At terminals where equipment lays over, trucks should be examined, all bolts tightened up, all worn parts which require renewing changed, brake connections and rigging keyed and bolted and cars inspected in general on the exterior and the interior for any defects, and proper repairs made.

Lubrication being one of the important items, journal box packing, brasses and wedges should be examined on arrival at terminals and given proper attention. Good results can be obtained by having a book of instructions for the lubrication and care of journal boxes.

The axle lighting system should receive careful inspection and proper repairs, and also be governed by a book of instructions for the maintenance of electric car lighting equipment.

Air Brake Maintenance

At terminals and repair tracks proper inspection must be made, and this can only be done by the use of a testing outfit, either stationary or on a truck. As the application and release of brakes are the two most important factors, it is essential that the rate of brake pipe reduction (to apply) and the rate of increase of brake pipe pressure (to release) be made as near as possible to actual operating conditions in order to determine that equipment will operate in a satisfactory manner when the car is placed in any location in a train, and the above cannot be accomplished if a too rapid reduction, or increase, is made. As for instance, the use of the angle cock, to apply, and the opening of the angle cock to which a yard hose is attached, for release, should not be considered as a test for the reasons given above.

At shops and repair tracks when triple and control valves are removed for cleaning and repairs, special attention should be given dirt collectors and strainers, as they perform an important part in keeping foreign matter from the valve mechanism.

The automatic slack adjuster when cleaned should be tested for leakage both in the piping and its cylinder. The brake cylinder piston travel should be let out beyond eight inches to ascertain if the adjuster is in proper working order. Oil or grease should not be used on the slack adjuster screw.

On cars equipped with P. C. equipment and automatic slack adjusters it is not only important that the travel of both the service and emergency brake cylinders be adjusted equal but it is also necessary to know that the service cylinder adjuster is in operating condition; as inoperation of this adjuster is very likely to result in tight brakes.

When brake cylinders are cleaned, a wooden paddle, the edges of which have been rounded, should be used in placing the packing leather in place in the cylinder. Many packing leathers are ruined by using chisels, or such tools as file shanks, or iron scrapers. The amount of lubricant used should be measured for each size of cylinder, not guessed at. The exact quantity of lubricant should be determined by a set of tin measures furnished, each measure stamped so the cleaner can know the proper amount allowed for each cylinder. An excessive amount of lubricant in brake cylinders is not only wasteful, but is liable to be forced into the triple valve mechanism, thus causing improper operation of the brakes.

The work mentioned above should only be done where proper air pressure is available, for to make repairs without making proper tests after equipment is applied to the car is out of the question.

All triple and control valves when cleaned should pass the prescribed tests for such valves before they are allowed in

service. This should also apply to new valves received as spares or on new cars.

The tests can best be made and better results had if valves are not lubricated before being tested, as in this manner worn bushings and poorly fitting packing rings can be detected; while, if lubricant is used, especially heavy oil or grease, the valve may pass the test O. K. and in a very short time fail in service. As the cost of cleaning and testing air brake equipment is no small item at the present time, we cannot be too particular in regard to the kind of repairs and efficiency of tests made in the air brake room. I might also add that past experience with lubrication of triple and control valves shows that the less used the better results will be had. Only dry graphite should be used on the slide valves and seats and then the quantity allowed to remain on the parts should be so small that it cannot be seen.

The improved method of testing triple and control valves devised by the Westinghouse Air Brake Company will give better results and all older types of test racks should be modified to the new, as the new method of testing for packing ring leakage and friction is far above the old.

The question of removing equipment from the car and sending to the air brake room for testing and cleaning on account of slid flat wheels, in the majority of cases is unnecessary, as the equipment can be properly tested by the use of a yard test truck, and when any equipment fails to pass such test it should be removed.

Weather and track conditions are responsible for more slid flat wheels than defective air brake equipment.

Car should receive proper cleaning on arrival at terminals and should be handled in a systematic manner and the interior as well as the exterior of the car should be well cleaned. The best result from this cleaning can be obtained by instructions on the proper method of cleaning cars at terminals, these instructions going into all details such as, general cleaning, interior cleaning, exterior cleaning and economy in material, and the workmen should be governed by the book instructions on cleaning.

Roofs of cars should receive regular inspection and be repainted when found necessary; floors, platforms and steps, and all iron work which has become rusted should receive same attention.

Shopping of Cars for General Repairs

General repairs to a passenger car is divided into three classes of repairs, viz.: A, B and C, which class of repairs denotes the paint operations only, and are explained as follows:—

Class A repairs covers the removal of all paint and varnish from the exterior of a wood car by burning, and a steel car by sand blasting, or when all sheathing or plates have been renewed.

Class B repairs covers the removal of all paint and varnish where necessary on a wood car exterior, painting the car complete, re-lettering and numbering.

Class C repairs covers the painting of the exterior, cutting around lettering and numbers, thus eliminating the additional expense of re-lettering and numbering.

When a passenger car arrives at the shops for general overhauling it follows the routine as designated.

1. *Inspection and Classification of Repairs.*—The receiving Inspector keeps a record of all cars arriving at the shop, and makes a daily report to the superintendent of shops. He records the number of the car, class, type, lighting, and any noticeable or carded defects. If the car is in a condition for general repairs, he shops the car for classified repairs, A, B, or C, noting any additions or betterments required. A "Bulletin Board," in the inspector's office, is maintained, showing the cars shopped daily.

2. *Stripping the Car.*—The foreman of the strippers notes the cars shopped daily and operations are started wherever the car is located in the yard. The stripped cars are spotted, and delivered to the wash shop via electric transfer table. All material is removed from the car and delivered to the various repair departments for cleaning, inspection and repairs.

3. *Wash Shop Work.*—When all material has been removed from the car, the interior is scrubbed, pipes scraped, if necessary, and the exterior is burned off or washed according to the class of repairs. Steel cars for sand blasting are delivered direct to the sand blasting room prior to entry in the wash shop.

4. *Repair Shop Work.*—When the car has been finished in the wash shop, it is then delivered to the repair shop, jacked up, placed on horses and the trucks removed for their repairs. After the car has been jacked up and trucks are removed, the car is given a careful inspection, defects noted and card attached to car, showing repairs, changes, etc., to be made.

During the course of repairs, the air, steam and water are tested and repairs made. Roofs are examined and repaired. Electrical work on car is also repaired. New wood applied, or plates renewed, is primed while the car is in the repair shops, thus saving time on the arrival of the car in the paint shop.

A bulletin board is maintained in the repair shop showing date in shop and date the car is due to be delivered to the paint shop, also all other parts removed by the strippers must move forward to the painters on the same day the car is delivered.

5. *Car Delivered to Paint Shop.*—When the car arrives in the paint shop, the car is inspected and a delivery date is forwarded to the delivering inspector, who makes a daily report, of cars to be delivered, to the superintendent of shops, who, in turn, notifies the superintendent of passenger transportation, when the car will be ready for service.

A bulletin board is maintained in the paint shop showing the dates cars will be ready for trimming, and all material removed must be ready for application.

When the painters have completed their work, the car is turned over to the trimming department, who trim the cars before they leave the paint shop.

6. *Final Inspection.*—The car is then taken out of the paint shop, placed on scales, weighed, measured for height and is then placed on the inspection and testing track.

Air, steam, water and electrical systems are tested, and the brakes and car adjusted. Final inspection is then made by the delivery inspector, and when all adjustments have been made the transportation department is notified that the car is O. K. for service.

(On motion the paper was received and ordered spread upon the minutes.)

A paper on the subject of lubrication by J. C. Stewart, foreman freight car inspectors, Cincinnati, Indianapolis & Western, was then read.

LUBRICATION REQUIRES ATTENTION

BY J. C. STEWART (C. I. & W.)

While I know that the interchange rules and car department work and duties will, as usual, be ably and efficiently discussed and handled from every angle during this convention, I have one great handicap in particular in mind, namely, hot boxes. I desire to suggest that the association arrange some means of urging and encouraging all the railroads to start a "more efficient understanding and service drive" along the lines of the care of the journal box.

We know that hot boxes are always caused by excessive friction, and that a vast amount of instruction as to the best method of handling lubrication, etc., has been issued from time to time. Notwithstanding this there still remains a great deal to be done before conditions will be as good as desired. While I am not in a position to state, neither do I

believe, that there is lack of efficient service in this line on all railroads; however, I do know that the majority of railroads have cars running throughout the country with such equipment in poor condition.

In many cases we find car oilers, box packers and even car inspectors who do not have the proper knowledge of the many causes of hot boxes, which cause a multitude of troubles and costs. All these troubles are caused by two conditions; either defective lubrication or excessive bearing pressure. However, we are aware that there are many details connected with the insufficient lubrication or excessive bearing pressure area, and, in order to get the proper results, all employees should know how and why they are caused. Unless they are familiarized with and we remedy these causes, we cannot successfully attempt to overcome or remove them.

Apparently, in many cases, authorities do not act in close enough relationship with these matters, thereby not following up and urging better conditions and attention. As, for instance: sending employees out along the divisions daily to repair hot boxes on cars set out of trains, and not keeping a record and check of the causes, etc.

There are many causes for the hot box situation that can be made readily remedial. I believe that the association through the officers or a committee could, by going in detail and following up these conditions, advocating better service to all railroads through correspondence, do a great service. I feel all officials and supervisors will consider that our best and most consistent friends are those who tell us of our faults, and they will thereby impress upon the minds of employees that if we want knowledge, like anything else, we must toil for it, and that the price of success in any line is not too great to pay. For the fit man, with no apology up his sleeve, is always admired.

On motion duly carried both papers were received and the subject carried over for next year, with the suggestion that a paper be prepared by M. J. O'Connor and the same committee continued. F. W. Trapnell then read the report on uniform inspection blanks.

REPORT OF COMMITTEE ON UNIFORM INSPECTION BLANKS

This committee was appointed at the annual meeting of the association held at St. Louis to look into the matter of a uniform inspection blank to be recommended to the Arbitration Committee of Mechanical Section III for their consideration and adoption, if in the opinion of this committee it would be necessary.

I have written all the interchange points of any particular note and secured samples that were being used at various points. We find all kinds of forms and some points with merely a book record. The book could easily be misplaced and the record of the car entirely lost. After considering the various forms submitted the chairman of the committee with A. Kipp recommend that the blank form shown herewith as Fig. 1 be used for points where the inspector merely takes the physical or mechanical conditions of the car, but at points where the inspectors, working under a bureau, take the records for the transportation department in addition to the mechanical department, we recommend that the form shown in Fig. 2 be used.

A. B. C. RAILROAD

DAILY REPORT OF CARS INSPECTED

Time ....Date ....19....

From ....To ....

Fig. 1—Form for Recording Physical Condition of Cars

The card for bad order safety appliances, should be printed on both sides as in Fig. 3, showing on one side where safety appliances have penalty defects and must go to the repair track for repairs and the other side showing safety appliances with penalty defects but light repairs that can be made in the yards by the light repair men.

Fig. 3—Card for Bad Order Safety Appliances

THE KANSAS CITY CAR INTERCHANGE BUREAU KANSAS CITY, MO.

From ______________ Ry. to ______________ Ry.

INSPECTOR'S NAME	Sheet No.	MONTH	DAY	YEAR
				191

INITIALS	KIND	NUMBER Loaded	NUMBER Empty	Hour Inter-changed	Destination or Consignee	Contents	SEALS Right Door	SEALS Left Door	CONDITION OF CAR

In "Kind" of Car Column use B for Box. S Stock. C Coal F Flat. R Refrigerator. T Tank. Fn. Furniture.

Fig. 2—Form to Be Used When Inspector Records Both Seal Record and Physical Condition of Cars

The committee is in receipt of a communication from T. J. O'Donnell, stating that at Buffalo there are two lines only having a form for handling their cars in interchange, the balance using a book.

Those are the only two members of the committee that I have heard from but I would recommend that the matter be

discussed and if in the opinion of the association such blanks should be recommended to the A. R. A., I believe that we will be making a move in the right direction as the Mechanical Section III from time to time has been simplifying and getting uniform rules and regulations, uniform cards for handling the business and a uniform blank would be not out of place so that the records could always be taken care of at a very little expense, a great deal less expense than by using a book record.

Discussion

After reading the report Mr. Trapnell said: The need for a uniform inspection blank was brought out by a freight claim agent of the Canadian Pacific who stated that without a proper record of a car at the initial loading point, the road loading the car would have to assume all of the responsibility for loss to that car. I have before me the blanks of the various interchange points throughout the country and I find that they are badly mixed up. Some have none; some have a blank piece of paper, without any heading, to be torn out of a book. These are easily misplaced unless a file is provided to keep them in.

The chairman of the committee corresponded with each point and after assembling the blanks and picking out the various kinds, each member of the committee having a copy of the blanks used by other points, the chairman took it up with all members, recommending a certain blank. I have a favorable reply from one member of the committee, Mr. O'Donnell, but he does not give his sanction of a uniform blank.

(A motion was made that the report be accepted and the matter referred to the Executive Committee for their handling at the February meeting and report at the next meeting.)

T. J. O'Donnell: My recommendation was on personal talks of our 150 car inspectors. They seem to all favor the book in bad weather. If you make out a blank statement today and file it in the office of the chief interchange inspector or a foreman is there any reason why an inspector, if he wants to make a false record, cannot get that blank and replace it with another blank? You fill the book from beginning to end. All you can do with that is simply to erase it. That was my reason for not voting affirmatively for the blanks. It seems to me, if you have the books properly filed, they will serve the purpose much better than the blanks.

W. J. Stoll: The form that is being used in our city is sent in by the inspector at the end of the day. One copy is filed in the chief interchange office and a copy of it is kept is his possession, or in the possession of the general foreman for him. The hard copy is sent to the interchange office and no inspector or anybody else can get in there without a key.

F. W. Trapnell: We use a blank and the inspector makes five copies of that inspection: one for the receiving line, one for the delivery line, one for the receiving agent, one for the delivering agent and one for the I. C. C. In that way we save an enormous lot of work by furnishing the agent the physical condition of the car when it is received, and when he gets his claim back he has the condition of that car.

T. J. O'Donnell: I favor the agent having a record. It saves a lot of correspondence. It would overcome 3,000 claims a month coming to our office.

President Gainey: We do the same as Mr. Trapnell, except that we do not give the agent a copy. The inspector takes the numbers and initials of the cars in his book. On those that are defective he notes the defects. After going through the cut, he takes the record to the shanty and writes three copies on a form: one to the delivering line, one to the foreman of the receiving line and one to the I. C. C. His own record is his book record.

W. M. Herring: We tried to get up some kind of a sheet instead of the five by nine book. Some claim they can carry a book in their pocket much handier than the sheet. We continued the book on account of the objections to carbon, and the disadvantage of carrying our sheets either in pad form or any other form.

President Gainey: That has been the general objection. Kansas City is about the only one that has used the loose leaf form.

M. W. Halbert: We tried the book record several years ago and now we use the sheet. The inspector writes the original record and takes a copy. The original he sends to the chief inspector's office, and the duplicate is sent to the foreman of the delivering line. We never have any trouble.

W. P. Elliott: In our district we take two and three copies of the record. I do not approve of making six copies of the record. Mr. O'Donnell is right; to put carbon in between four sheets of paper in rain or snow you have a job. I approve the loose leaf idea. It gives a better filing system in the office. I do not think it is a good idea from a practical standpoint to furnish the agent a copy of that record, because they have all of these records in their own office and I am satisfied there is less expense when we furnish them than in furnishing to all of the agents. If you put another man in the office it would be cheaper if you figure the time the inspector consumes in doing this extra work.

E. H. Mattingley: I want to agree with what Mr. Elliott has said. I think the car inspector today has all he can do without making five carbon copies of his records as to the condition of a car in interchange. If he will carry out the inspection according to the rules, take care of running repairs on defect cards, he has about all any man wants to do. We have joint bureaus at the large terminals and they get the original record at the time the car is inspected. If anybody else wants it, why not get it from that office?

F. W. Trapnell: I did not recommend that in the report. I simply said we did that. I do not care how many copies you have, but the idea that Mr. Mattingley laid down is not a correct one to place before this convention. The inspector makes five records with one scratch of the pencil. The car inspector is not so loaded down with work. The carbon is changed in the twinkling of an eye.

W. P. Elliott: I agree with Mr. Mattingley and disagree with Mr. Trapnell. The most disagreeable thing a car inspector has to do today is to change the carbon. I know whereof I speak. Many a time I have written my records on a bad night and found that I had the carbon upside down.

T. S. Cheadle: I know from experience that the form as recommended by Mr. Trapnell can be used, for so far as the use of carbon, if a man wants to do a good job he can come pretty close to doing it, and if he wants to make a bad one he can do it. As I understand it, Mr. Trapnell is not recommending his way.

A. A. Helwig: It does away with much correspondence with the agent. Where we get 10 or 15 claims from the agent, it means taking down back records. At Kansas City they let the agent do it himself.

W. J. Stoll: Our system has been in force since 1910 and the trouble with it from the agent amounts to nothing. The records are so handy that in a very few minutes we can dig up records of five years back.

E. R. Campbell: We are using the type of blank furnished by Mr. Trapnell. We only make three copies, one copy for the chief inspector's office, one for the inspector on interchange and one goes to the Western Weighing Association, which has a bill of lading over all the roads.

E. H. Mattingley: I do not want Mr. Trapnell to understand that I am taking exceptions to his form, but I do object from practical experience in trying to insist on a car inspector making three or four copies at the time he inspects his car.

President Gainey: One of the finest records I ever saw in a chief interchange inspector's office was in Mr. Stoll's

office at Toledo. I could pick out anything in 5 to 10 minutes. I do not approve of making four or five of these copies, as suggested by Mr. Trapnell, but I do believe in a regular form. The inspector takes his record in a book of the entire cut, and makes a report to the delivering line, the foreman of the receiving line and one to the chief joint inspector, keeping the book record. If the claim agent wants to know anything about that car and can give the date received the inspector will give him the defects in less than five minutes. We ought to have a regular form, but like the others, I do not think an inspector should be required to make four or five copies in the yard.

F. W. Trapnell: That isn't part of my recommendation. The only recommendation is that we have a uniform blank.

M. W. Halbert: We have used a form 3½ in. by 9 in. for 10 years. The inspector uses one piece of carbon and takes two copies. We have a pigeonhole just the size of these slips. We have 24 railroads and 100 connections from which we receive these daily reports. All cars received by each line are separated. All cars delivered by the same line are kept separate. All we have to do is to go right to the pigeonhole. We can get a record in two minutes of every car that is handled. The reason we made the form that size is that it fits the inspector's pocket. We have no trouble whatever. It is a nice clean proposition for the inspector and everybody else.

A. Kipp: I was one of the committee and it does not seem to me that we are getting anywhere, or that this body could do anything more than make a recommendation that this blank be a standard blank to be used throughout the country for making records, and until such time as that is approved by the A. R. A. we have no authority to say that it shall be used. We can go on and keep just such records as we see fit, and if we do not agree to use this blank we can use a book. It seems to me with all this discussion this association should do one thing or another, accept this committee's report and recommend a blank, or to reject it.

W. M. Herring: In the southeast we cannot require an inspector to furnish a record to the transportation department. Any information they get, must be obtained from the mechanical or car department. (The motion for the adoption of the report was put and carried.)

Secretary-Treasurer's Report

The Auditing Committee reported that the books of the secretary-treasurer had been audited and found correct.

REPORT OF SECRETARY-TREASURER.

Cash on hand, Sept. 23, 1919		$125.75
Collections for Dues, 1919-1920		1,106.00
Total cash on hand		$1,231.75
Disbursements—		
Reporting 1919 Convention	125.00	
Subscriptions to *Railway Mechanical Engineering*	520.50	
Postage	48.00	
Printing and stationery	157.89	
Officers' badges for W. J. Stoll, H. J. Smith, W. McMunn	90.00	
Salary of Secretary	150.00	
Miscellaneous expense	21.24	
		1,112.63
Total disbursements		$1,112.63
Balance on hand		119.12
Members in good standing Sept. 23, 1919	240	
New members	109	
Members in good standing Sept. 14, 1920	349	
Members deceased during the year— C. D. Mitten, St. Paul, Minn.		

Election of Officers

The following officers were elected by unanimous vote: President, Edward Pendleton, general foreman, Chicago & Alton, Chicago; first vice-president, A. Armstrong, chief interchange inspector, Atlanta, Ga.; second vice-president, W. T. Westall, special inspector, New York Central, Cleveland, Ohio; secretary, W. P. Elliott, general car foreman, Terminal Railroad Association of St. Louis, East St. Louis, Ill. Members of Executive Committee (to fill vacancies): W. H. Sherman, car foreman, Grand Trunk, Sarnia, Ontario; A. Herbster, assistant master car builder, New York Central, Chicago.

Other Business

At the Thursday morning session, the arrangement made for publishing the official proceedings of the convention in the *Railway Mechanical Engineer* was ratified and the matter was left to the Executive Committee for further action next year.

The entertainment provided by the Supply Men's Association during the meeting included a trip to the top of Mt. Royal; an informal reception and ball; a tea party; a theatre party; and a sight-seeing trip around the city of Montreal.

The resolutions committee, T. J. O'Donnell, chairman, reported as follows: The members of the Chief Interchange Inspectors and Car Foremen's Association of America in closing their twentieth annual convention in the city of Montreal, Quebec, wish to repledge and offer our fullest individual and mutual support to the mechanical and car department officials throughout the country for the purpose of bringing about the very best and most efficient service that the public and higher executives demand or hope to carry on in the future, realizing the efforts and labor required from each and every one in railroad service to bring such results about.

The Chief Interchange Car Inspectors and Car Foremen desire to express their united appreciation and sincere thanks in closing this annual gathering in Montreal to the following who have contributed to the success of this meeting and the pleasure of the guests while in this City:

First, to the City of Montreal, including the press, and the officers of law on the street, for their uniform courtesy.

To the Hotel Windsor for their excellent service and permission to many of our members to sit up all night in their lobby. (Applause.)

To the beloved and loyal gentlemen of the Supply and Entertainment Committee for their indefatigable and unceasing efforts at this convention, as in many of the past, to make our stay and convention such a pleasant and grand success.

To the railway officials in this district, particularly James Coleman, of the Grand Trunk, to E. Arnold, of the Grand Trunk, to J. E. Grant and T. O'Donnell for their inspiring talks and valuable suggestions for the guidance of this association, as well as to the officials of the Canadian Pacific and other railways for their attendance and interest in our numerous gatherings, and help in making our stay most pleasant and return to our homes most agreeable.

To our presiding officer, J. J. Gainey from Ludlow, Kentucky, we tender our heartfelt thanks. While we have known his genial and pleasant disposition in the past, we have gladly recognized it in the highest position of our association, that of presiding officer.

To our secretary Mr. Keene, who leaves us after one year of service, we extend our sincere thanks for his efficient service. We are very grateful to Miss Unkenholz for her courtesy as our stenographer. And to all the people in Montreal who have contributed toward our pleasure while we have sojourned here, we are deeply indebted.

May we return to our homes full of hope, and may future gatherings, wherever they may be held, be as pleasant and splendid as this great convention has been in Montreal.

The convention closed with the singing of the national anthem of the United States.

CANADIAN PACIFIC HOPPER BOTTOM BOX CARS

High Radio of Load to Gross Weight in New Equipment Designed Especially for Grain Service

TWO features which make the equipment particularly suitable for service on a road with a heavy grain traffic stand out strongly in the design of the latest box cars recently placed in service by the Canadian Pacific. The limit load which the cars will carry is 60½ tons and the floors of the cars have special hopper bottoms which are designed to facilitate unloading of bulk material and to eliminate the need for temporary grain doors. Roads that have a heavy merchandise traffic generally consider that the cubical capacity usually limits the load in a box car and, therefore, a 40-foot car with a limit load of about 45 tons is most economical. However, where much grain and coal are carried in box cars, as is the case on the Canadian Pacific, the extra cost of the heavier car is, no doubt, more than offset by the higher ratio of load to total weight in a fully loaded 60-ton car. In these cars, which are 40 ft. 6 in. long, 8 ft. 6 in. wide and 9 ft. high inside, the ratio of load to gross weight is 71.4 per cent.

Box Car With Burnett Hoppers Built for the Canadian Pacific

Type of Construction

The cars are built with steel underframes, steel side frames, corrugated steel ends and outside metal roofs. The center sills consist of two 12-in. channels continuous from end to end of the car. The bolsters and cross bearers consist of pressed steel diaphragms with top and bottom cover plates, while the floor beams are pressed steel diaphragms. The decking, which is 2¼ in. thick, is secured directly to the center and side sill flanges by means of bolts.

The side frame consists of 9-in. channel sills, 6 in. by 3½ in. by ⅜ in. angle plates, 4-in. Z-bar door posts and U-shaped pressed steel posts and braces. The side sheathing, which is 1½ in. thick, is bolted to the flanges of the door posts, pressed steel intermediate posts and braces and to the flanges of the corrugated steel ends. Pressed steel posts and braces were chosen in preference to rolled sections because the ends have area for riveting without the use of gusset plates, and the ends of the braces can be brought much closer to the ends of the posts; also the pressed shapes provide superior support for the sheathing boards. The ends of the car are of pressed steel, each end being in two sections.

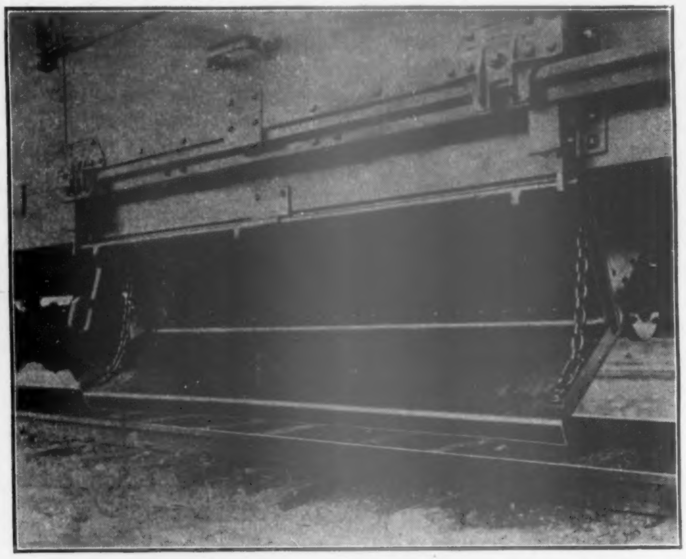
The roof is of the flexible outside metal type supported on metal carlines. All carline flanges are covered with strips of wood arranged to prevent the accumulation of dust that might be shaken down from time to time and possibly damage the lading.

Grain Hoppers

Hoppers of the Burnett type are located at the side door opening on each side of the car. When used for freight that cannot be dumped through the hopper the car has a solid level floor, the same as an ordinary box car; when grain coal, etc., are to be loaded the specially constructed sections of floor over the hoppers are turned up against the side door post. This arrangement allows the load to go directly into the hoppers, and also saves considerable temporary door lumber. When the cars are unloaded it is only necessary to remove the pin that locks the hopper doors; the doors open quickly by gravity and immediately a large percentage of the contents of the car discharges through the hoppers. The balance of the load may be shoveled to the middle of the car by hand, or if the unloading plant is equipped with power shovels, as most elevators are to-day, the floor door on one side of the car is released from the door post and the cables are taken through the door opening as usual. The

hopper doors have no operating mechanism, the doors being closed directly by hand and secured by a simple locking bar arrangement.

Special care has been taken to obtain a side door of satisfactory design. The interlocking front and back edges afford exceptional protection against weather and pilfering. The top edge is thoroughly weatherproof, yet so arranged that it cannot become blocked with ice. The bottom of the door is fitted with turned rollers that fit on a very substantial and rigidly supported track.

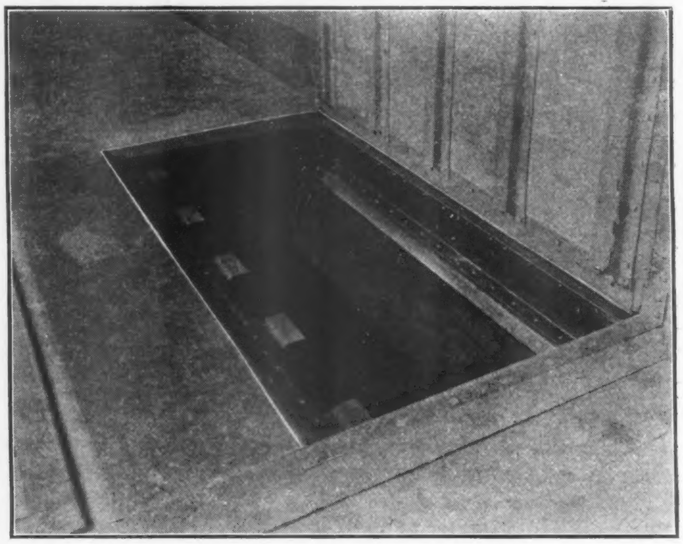


The Hopper When Open Discharges Outside the Track

This track is not likely to be blocked with ice but in case it should be the interference is plainly visible and easily removed. The location of the rollers at the bottom of the door does away with the binding or cramping so frequently noticed on doors suspended from the top.

The brake arrangement includes a manually operated slack adjuster, which is a double safety device, as it enables inspectors to adjust the brakes to compensate for wear on brakeshoes without going under the trucks; and, as no truck parts are disconnected, the possibility of trouble due to oversight in replacing connection pins is eliminated. As the time required to adjust the brakes by this device is much less than with the old arrangement it enables inspectors to give attention to more cars in a given time, thus resulting in better maintenance and less detention. The hand brake arrangement is specially designed to be operative regardless of climatic conditions, this being accomplished by arranging the ratchet, pawl, etc., so that snow or ice on top of the parts will not interfere with their operation. The entire arrangement is located overhanging the end of the roof so that it is impossible for even the deepest snow to pile up underneath. The ratchet pawl is of the gravity type, and therefore the trainman is not required to use his feet for holding the pawl in position.

Interior of Car With Hoppers Closed



Floor Section Raised for Grain Loading

The trucks are of the standard arch bar type with improved truck columns, spring plank and truck column fastenings, pinless brake beam hanger brackets, and four-point brake beam suspension. The railroad states that up to date this type of truck has given the best satisfaction in Canada.

THE SUCCESSFUL FOREMAN*

BY W. P. ELLIOTT
General Foreman, T. R. R. A. of St. Louis

To my mind a successful foreman possesses two very important qualifications. One is loyalty, and the other is ability, which, of course, covers a very broad scope. It has been said that an ounce of loyalty is worth a pound of cleverness. I have often thought in my contact with men and in the daily performance of my duty how necessary loyalty was to success. Be a man ever so clever, without loyalty to the company or individual he is working for, his cleverness or ability is liable to be more detrimental than beneficial.

During the period of federal control I visited nearly every car shop and repair shop in the St. Louis and East St. Louis terminal. During that time the salary of a car foreman was hardly in proportion to the ability and responsibility expected. That has, in a large measure, been rectified since that time. However, I could not help noticing the attitude of some of the men filling supervisory positions. Regardless of the wage conditions or the working conditions under which foremen were working at that time, there was hardly any excuse for the attitude of some of them. The dissatisfaction was so apparent that it had its effect on the men that were working under the foreman. That "don't care" spirit went out to the men they were expected to lead, and the result was about what was to be expected.

I think one of the best characteristics of a foreman should be his ability to overcome difficulties, personal difficulties as

*From an address delivered before the St. Louis Car Foremen's Association

well as difficulties that come up in his daily work. If the foreman would be successful, it is essential that he be considered as to his capacity for accepting responsibility and his capacity for leadership. I do not know exactly what to attribute the lack of acceptance of responsibility to, unless it is due to labor organization. It seems that labor organizations have caused men, rather than leaning on their own responsibility, to lean on some organization or some set of men. For a man to be successful in a supervisory capacity, he should lean entirely on his own resources. Within the past two years especially there has been a disposition for men to say, "Why should I want the responsibility? Why should I take the leadership." And to my mind those men are not successful foremen.

When a foreman is given charge of a plant, regardless of its size, he should feel the responsibility of the management of that plant, and he stands in identically the same relation toward his superior as the general manager stands toward the corporation. He should be keenly interested in the success of that plant, and he should be keenly interested in the economical operation and should feel the same responsibility regarding its management that he would feel if it was his own individual property.

The car foreman today has an exceedingly responsible position. As an example let me cite the hazardous and highly perishable commodities now handled in tank cars. Few foremen realize the responsibility connected with the handling of this class of equipment. The tank car itself is relatively simple, but the commodities it carries makes exceptionally intelligent handling necessary. I have found that the simplest of defects have been considered serious by many car foremen and inspectors and many of the more serious defects have been considered simple. This has been due to lack of knowledge of the cars and their commodities. A foreman should know the United States Safety Appliance laws, and he should know well the rules of the Mechanical Division of the American Railway Association, and he should subscribe for books and periodicals that deal with the car department.

There are very few periodicals at the present time that go into car department matters very thoroughly. However, the car man himself is as much responsible as the publisher, if not more so. Publishers are always glad to receive subject matter from men who are on the ground, but car department matters have been principally covered by mechanical engineers, bill clerks, master mechanics and others who would be less liable to understand real car conditions and methods than the car man.

One of the features in being successful is to properly spread abroad your ideas so that other car men will have a chance to criticize them, either favorably or unfavorably. To my mind there is no other one thing that so broadens a man as association and discussion of the problems that confront us in our daily activities. I would like to see the car foremen get the habit of reading articles and talking upon matters that concern our daily duties.

For instance, as an idea for a subject, how far have we gone into the question of economical lubrication? What ideas have any individual car men put out as to the preservation of cars by painting? What ideas have we put forth or what action have we taken towards the proper inspection and the maintenance of draft gears, and what system of repairs have we suggested for draft gear, which is very essential to the proper handling of freight cars today? I recall very few papers that have been written on the question of brake beam failures, and yet there is no other one thing that is as important to us today. I think it would be a good thing for you, a good thing for the association and for car men in general, if there was more written on these subjects and more discussion of them by practical car men.

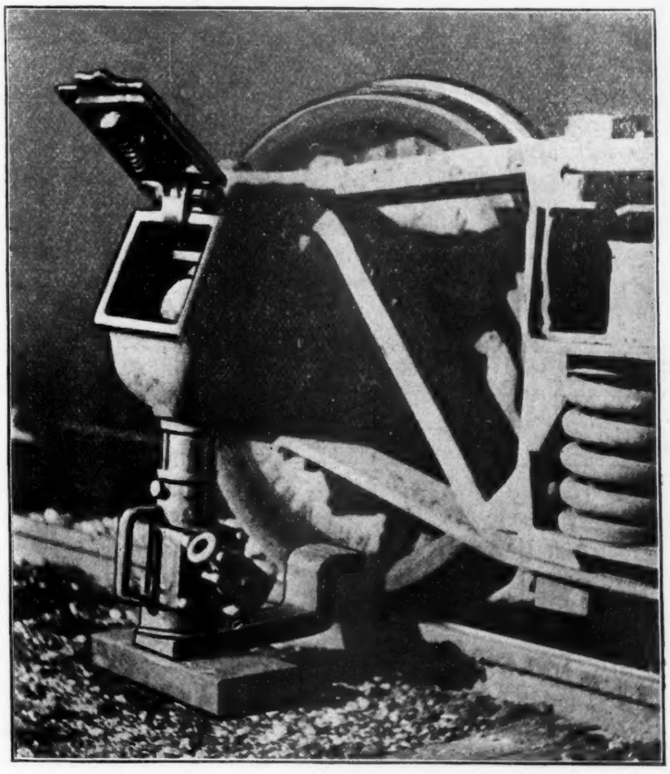
There is much that could be said that would be of assistance to car men towards success, but the things that come most forcibly to my mind are: be loyal, respect your superior and if there is any shortcoming, see that he knows about it, and I am sure that you will be given proper consideration. Invite responsibility. If there is any one thing that will make for success, it is that. Everyone admires a man who invites responsibility, and it gets back to the old saying that a man who does not make a mistake is not a real man. When you invite responsibility, you invite mistakes, and when you invite mistakes, you are showing your superiors that you are at least progressing.

SIMPLE DEVICE AIDS IN CHANGING CAR JOURNAL BRASSES

BY ROBERT I. LILLIE

All car shop employees, especially those responsible for work on the rip track, realize the difficulty that often is met in changing brasses or making other repairs to journal box parts. It is necessary to use a jack to lift the box from the journal and many times the wheel raises at the same time and has to be driven back by hammers or wedges between the wheel and the car body.

To obviate this difficulty a simple arrangement, illustrated, has been devised. An old brake beam lever is bent as indicated and placed with one end resting on a block, the



Efficient Arrangement for Jacking Up Journal Box

other offset end being supported on the inside rim of the wheel. When a jack is applied between the brake lever and bottom of the journal box, it is evident that operation of the jack will cause the journal box to lift, the wheel being held down by one end of the brake lever.

By placing the jack a little nearer the rail than shown in the illustration, there will be even less tendency for the wheel to lift. This device is sometimes called a wheel holder. When made from scrap truck levers it is inexpensive to make and its use results in a considerable saving of time and labor in making journal box repairs.

LINING DRIVING BOX SHOES AND WEDGES

A Shoe and Wedge Lay-Out Which Involves Little Possibility of Error; Pedestal Jaw Grinding Machine

BY J. McALLISTER
General Foreman, West Albany Shops, New York Central

ONE important object in laying out shoes and wedges is to place driving wheels under the locomotives so that the tire flanges will not cut or wear more on one side than on the other. That this object is not always attained with the usual method of laying out shoes and wedges is evident from the large amount of flange cutting which is found in practically all locomotive shops. It is a common occurrence, after a locomotive has received general repairs to see on the work report, "Throw wheels on account of flanges cutting."

Years ago when locomotives were small and parts light and easy to handle, a sharp flange was not so serious a matter as at present when motive power is relatively heavy. At the present time a flange which shows signs of cutting is often neglected until it becomes so bad that the wheels must be dropped and tires changed, or the locomotive sent to the shop for tire turning. The result is a low mileage and high cost of maintenance.

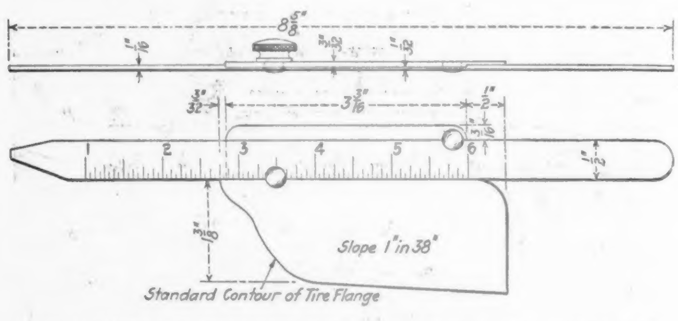


Fig. 1—Gage for Measuring Distance Between Tire Flange and Locomotive Frame

The method usually employed in laying out shoes and wedges is to work from the centers of the cylinders, tramming back to the frame jaws. There really is no good reason for working from the cylinders, however, as the only connection between them and the wheels is the main rods, and they must be adjusted to equalize piston clearance. With this fact in mind and with a view to getting data which would demonstrate the value of the proposed new method of laying out shoes and wedges, the gage shown in Fig. 1 was made. This gage consists of a piece of 3/32 in. steel shaped as indicated to fit the standard contour of a tire flange. A movable or sliding scale, graduated as shown, is arranged to be clamped in any desired position by means of a thumb screw. The method of using this gage is plainly shown in Fig. 2 and consists in measuring accurately, at the two positions shown, the distance between the working side of the flange and the frame. The theory was that if these distances proved to be equal, the flange must be parallel to the locomotive frame and would not, therefore, cut or wear away faster than the flange on the opposite wheel.

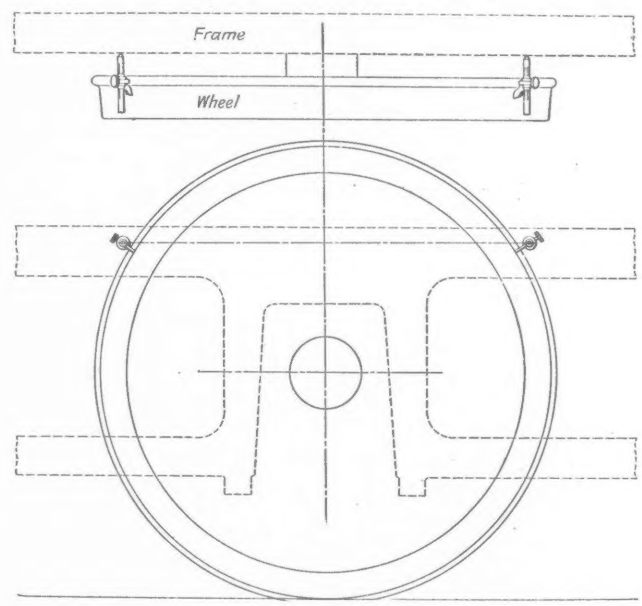


Fig. 2—Method of Using Gage

Several precautions had to be observed in the use of the gage. It could be used in the case of turned tires only because of the possibility that new tires might not be shrunk on in exactly the right place. It was found necessary to check only the main wheels, the other wheels being trammed from the centers of the main wheels. In taking measurements with the gage, two points were selected on the front and back of

the wheel on a line parallel with the top of the frame. This is illustrated in Fig. 2.

All locomotives coming to the shop for a certain period were tested with the gage previously described, and it was found that when the wheels were parallel with the frame, all flanges were worn evenly; when not parallel, they were cut on one side or the other. The practice was then adopted of gaging the wheels in the shop after the locomotive had been wheeled, the shoes, wedges and binders put in place on the main jaws and the wedges set up tight. When the gage showed that the flanges were not parallel with the frame, the

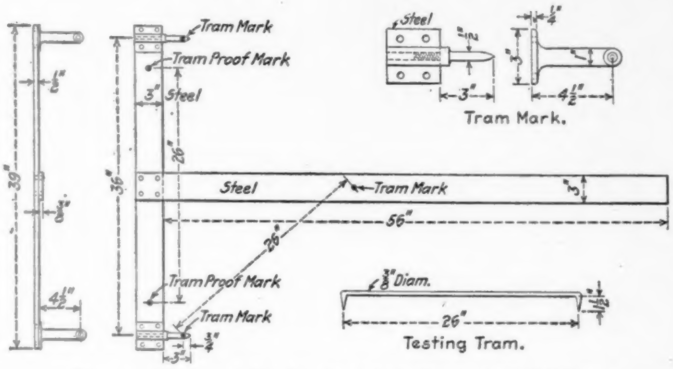


Fig. 3—T-Square for Laying Out Shoes and Wedges

binders were pulled down and the shoes and wedges relined to correct the error.

The results of the above practice were in a way surprising. No matter how carefully the laying out was done, it was found necessary to throw the wheels more or less on about 60 per cent of the locomotives. The improvement in flange cutting which followed was so pronounced that the extra work entailed in throwing the wheels was felt to be well worth while. Practically doing the work twice, however, was expensive and the attempt was made to find a better method of laying out shoes and wedges.

Method of Laying Out

Having proved conclusively that flange cutting on one side of a locomotive could be eliminated if the work was done properly and checked with the gage, it was decided to standardize the work and develop a set of jigs and gages which would reduce the possibility of errors to a minimum. The method of laying out is explained, the jigs and gages being described in the order in which they are used.

After locomotives are stripped in the erecting shop and necessary bolting done, the frame jaws are inspected by the erecting shop foreman in charge. If the jaws are found to be worn, they are trued up with the grinding machine illus-

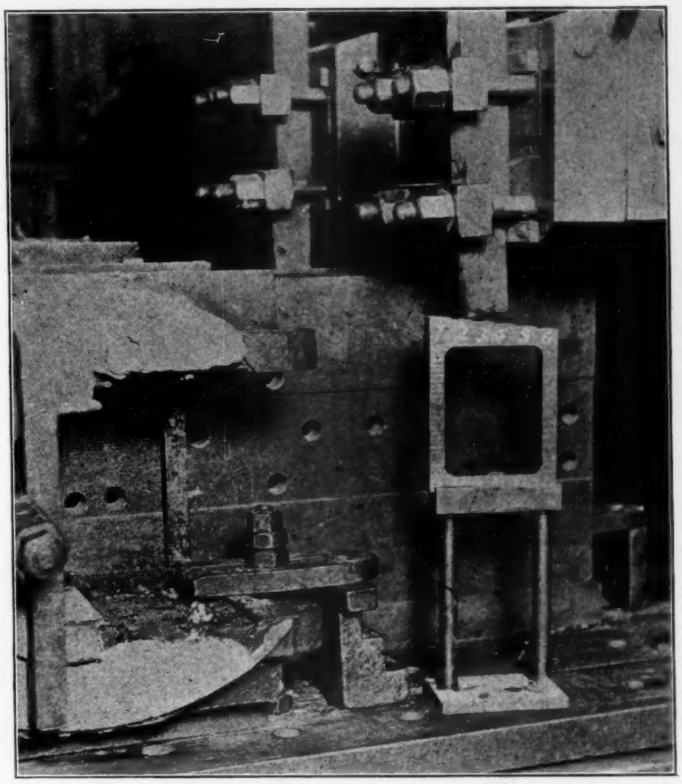


Fig. 5—Gage Used in Setting Tool for Planing Boxes

trated and described later on in this article. This machine does accurate work, saves the labor of filing and removes just enough metal to true up the surface of the jaw.

Referring to the lay-out shown in Fig. 4, the box center is located on the main jaw and a vertical line drawn through the center, using a small square. The T-square, illustrated in Fig. 3, is now brought into use. This is not a plain T-

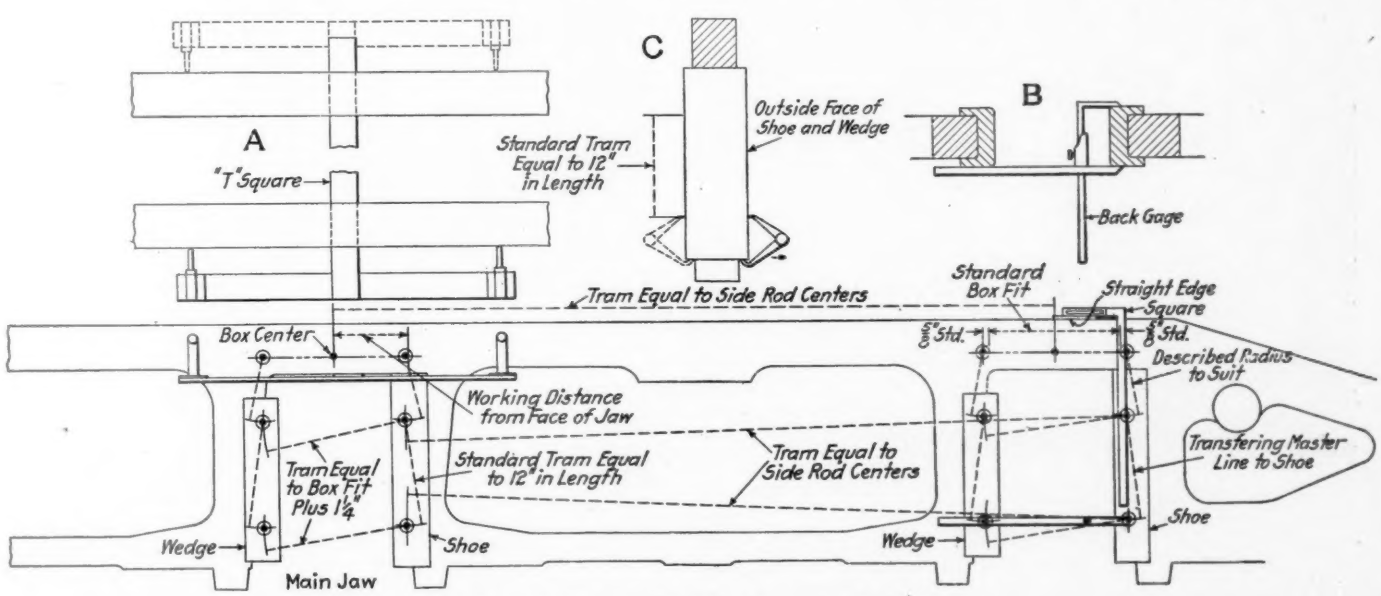


Fig. 4—Method of Laying Out Shoes and Wedges

square, but has two projecting points raised a set distance above the square, an arrangement which clears the bolt heads and allows the points to come in contact with the frame at points not subject to wear or incorrect alinement. As shown in the illustration, a 26-in. testing tram is provided to make sure that the square is correct each time before it is used. The testing tram itself may be checked from time to time by means of two points shown on the T-square head 26 in. apart.

Referring to Fig. 4, the T-square is now placed across the frames as shown at *A* and the box center transferred to the opposite frame. By placing the square on the other side of

ENGINE NO.___________			
BOX	GAGE NO.	BOX	GAGE NO.
R-1	1	L-1	1
R-2	1	L-2	1
R-3	1	L-3	1
R-4	1	L-4	1

ENGINE NO.___________			
BOX	GAGE NO.	BOX	GAGE NO.
R-1	1	L-1	3
R-2	2	L-2	4
R-3	1	L-3	1
R-4		L-4	

Fig. 6—Charts Showing Gage Numbers to Which Boxes Must Be Planed

the locomotive frame, the work can be checked by squaring back. If the marks do not coincide, the frames are out of parallel, in which case lines are stretched through the center lines of the cylinders to determine where the frames are out. If the marks check, however, the frames are square and work on the lay-out may proceed.

A careful consideration of Fig. 4 will make the method of

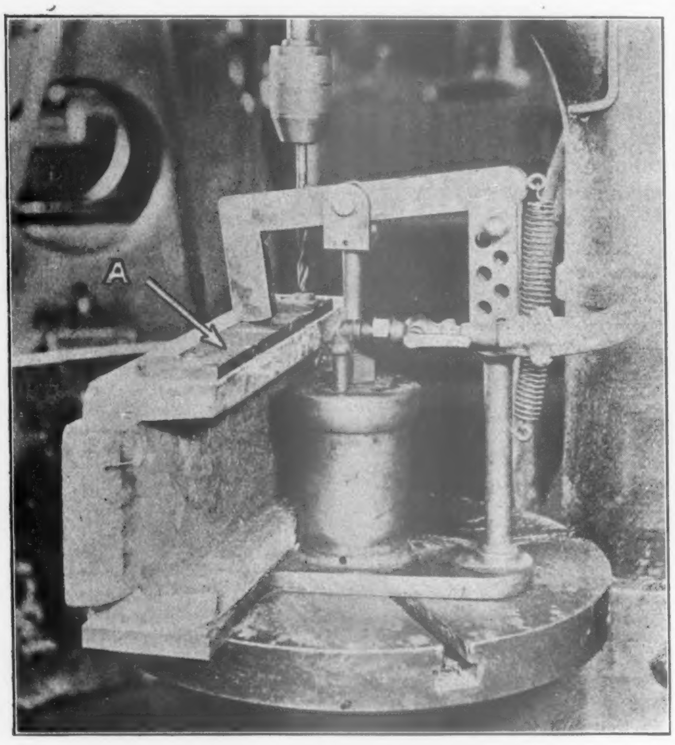


Fig. 7—Jig Used When Drilling 3/8-In. Location Holes

laying-out practically self-evident. A square and straight edge are used, as shown to square down from the top of the frame and proof marks are prick punched 5/8 in. outside of the driving box sizes, the standard box sizes being those shown on the blue prints for the particular class of locomotive involved. When all shoes and wedges are laid out on the outside of the frame, the marks are transferred to the inside of the shoes and wedges, using a back marker, shown at *B*, Fig. 4. The vertical positions of the proof marks are transferred as shown at *C*, Fig. 4. This provides a form of layout which is necessary when using the shoe and wedge planer to be described later. The responsibility of the erecting shop, except for a final checking, is now ended.

Machining Driving Boxes, Shoes and Wedges

Driving boxes are delivered to the machine shop, new crown brasses applied and the shoe and wedge fits relined.

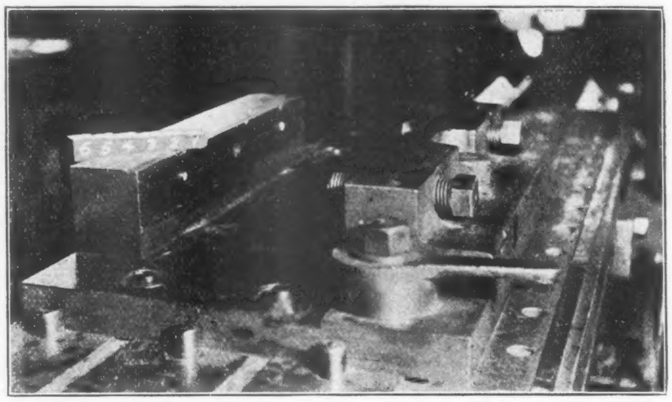


Fig. 8—Shoe and Wedge Planer Chuck

The boxes are then placed on a planer and machined to a standard size, using the gage shown in Fig. 5, a separate gage being provided for each class of locomotive. The driving box is then stencilled to show the size between shoe and wedge faces and delivered to the boring mill, where it is bored to actual size, a universal chuck being used to center the box.

It will be noted that the gage illustrated in Fig. 5 is a step gage, each step decreasing by 1/8 in. This arrangement is to provide for light repairs when driving boxes are not rebrassed but simply trued up. The tool is set to whatever step the box will true up at and stencilled 1, 2, 3, 4, 5 or 6, as the case may be. A chart is now made out by the wheel foreman,

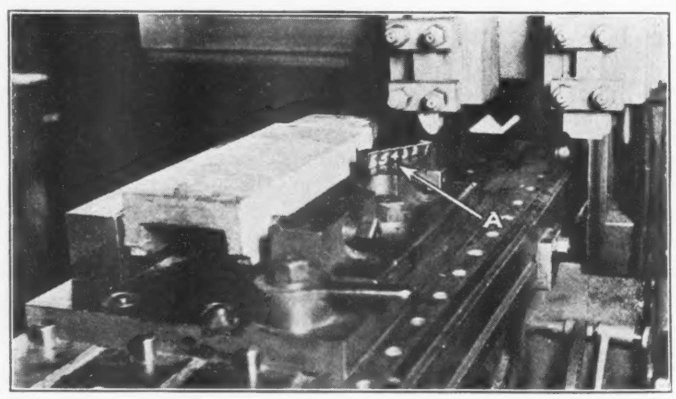


Fig. 9—Driving Box Shoe Set Up Ready for Planing

as illustrated in Fig. 6, showing the locomotive number, each driving box number, and the gage number to which it was planed. Two charts are shown in the illustration, one being for a set of driving boxes rebrassed and planed to standard sizes, and the other showing the sizes to which a set of light repair driving boxes were planed without being rebabbitted. The chart after being made out is delivered to the man who operates the shoe and wedge planer.

While the driving boxes are being planed, the shoes and wedges are delivered to a sensitive drill, which is placed near the shoe and wedge planer. The jig *A*, Fig. 7, is then used in drilling the holes which are to hold the shoe or wedge in correct position for planing. As shown in the illustration,

the jig consists of a metal bar with a hardened steel bushing in either end to guide the ⅜-in. drill. These bushings are 12 inches apart, as are the two guiding points arranged to enter the proof centers and thus indicate the correct position for the jig. The jig is held in place by means of a pneumatic clamp, as shown in Fig. 7, and two ⅜-in. holes are drilled ¼ in. deep on each side of the shoe or wedge.

The shoe or wedge is now placed in a chuck, shown in Fig. 8, being held in the correct position for planing by means of ⅜-in. pegs in the chuck body entering the ⅜-in. holes previously drilled. Two of the ⅜-in. pegs are shown in Fig. 8, the other two being machined on the ends of the holding set screws. The jig and chuck, shown in Figs. 7 and 8 respectively, are designed so that when the shoe or wedge is clamped in position the proof center marks are exactly in line with the top of the chuck. A driving box shoe held in position ready for planing is shown in Fig. 9. The proof circles extend ⅝ in. above the top of the chuck. The gage at *A*, Fig. 9, is placed on top of the chuck and the planer tool set to the step called for on the chart, previously issued to the planer operator. Thus, if the box is a standard size, the tool is set to No. 1 step; if it has been planed down and is not a standard size, the tool will be set to the required step. It will be noted that steps on the gage increase by

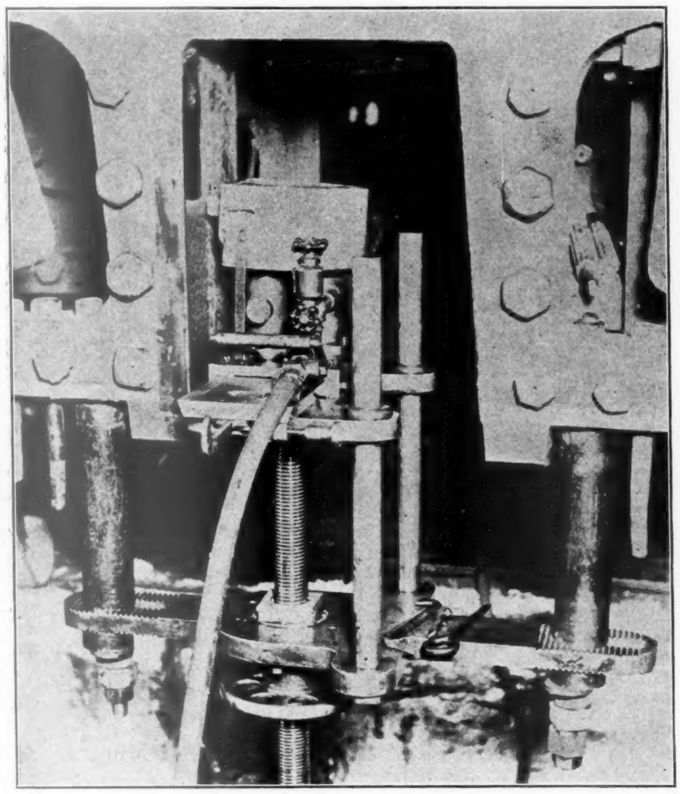


Fig. 10—Pedestal Jaw Grinder Set Up Ready for Operation

1/16 in. so that if the driving box is planed ⅛ in. small, the shoe and wedge by this method will each be planed 1/16 in. large. The chuck automatically sets up the shoe or wedge parallel ready for planing, and the gage determines the tool setting without any further measurements.

Frame Jaw Grinder

It is necessary to start with frame jaws which are true. With cast steel frames, which are naturally tough and become almost case hardened in service, it is practically impossible to true up a frame jaw by filing. Various attempts have been made to perform this work by machinery and one device was designed to machine the jaws by means of a portable milling machine. The two objections to this device were its lack of rigidity and the danger of removing too much metal. Obviously the best method would be to use some form of grinding machine which would cut no matter how hard the surface and remove only enough material to true up the jaws. The machine illustrated in Figs. 10 and 11 was devised for this purpose. As shown in the illustrations, power is supplied by means of an air motor driving a 1 in. by 8 in. grinding wheel through one pair of gears. Both the motor and grinding wheel are arranged for vertical movement by means of a square threaded screw, guided by two upright rods securely fastened in the base plate. The grinding wheel is guided in its horizontal movement across the face of the frame jaw by means of the V-ways shown. The device is supported by two bolts through the bottom frame rail, the base plate being held at the required distance from the

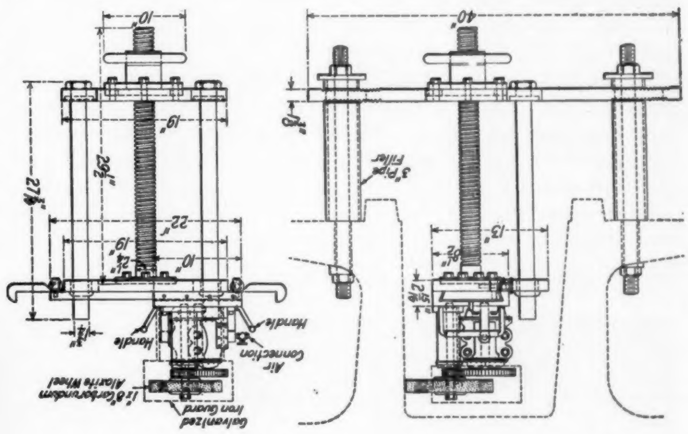


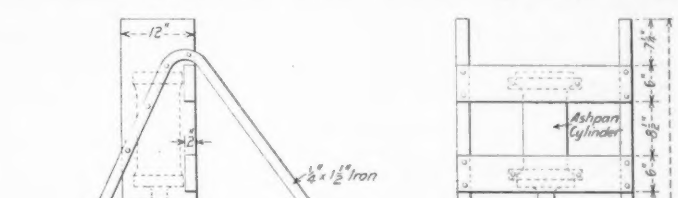
Fig. 11—Details of Pedestal Jaw Grinder

rail by means of two pipe thimbles. When it is desired to grind the wedge jaw face a set of pipe thimbles are used which are cut off to hold the base at an angle of 5 deg. This arrangement brings the two machine guides parallel to the frame jaw. A galvanized iron guard is provided for the wheel, as illustrated. Experience has shown that this grinder does a first-class job, especially on wide extension frame jaws, and removes just enough metal to true up the jaws.

PRESS FOR FORMING STACK HOODS

BY C. E. YOCUM

On roads where a hood is used over the stack to avoid setting fires from cinders, the press shown in the sketch will be found a great labor saver. The netting is cut to the



Air Press Reduces Labor in Forming Stack Hoods

proper size and placed centrally over the hole in the base of the press. The air-operated cylinder forces the former down and draws the netting into the proper shape, thus greatly reducing the hand work required.

THE TESTING OF WELDS IN STEEL PLATES*

Conditions Which Affect Quality of Welds; Simple Bend Test and Etching of Sections Recommended

BY S. W. MILLER
Rochester Welding Works, Rochester, N. Y.

THERE have been many failures of welds in the past, some not explained and some very expensive. As in all other developments, welding first received its principal impetus from the practical man. Of late, however, the tendency has been to investigate more carefully and more fully and by means not available to the ordinary welder. This means that scientists of all kinds have been called into consultation and that almost every conceivable method of test has been suggested in order to determine what methods and materials would make the best welds both from a standpoint of security, service and cost. While some of the methods employed at present are beyond the reach of the ordinary welding shop, yet they are of great value and, in fact, necessary in order to determine correctly what has occurred during the welding operation and what results may be expected under given conditions. Most of the published results are incomplete in one or more respects and one of the objects of the American Welding Society is to put the testing of welds and welded structures on a firm and safe foundation.

Common Methods of Testing

The testing of metals, aside from welds, is quite well developed both in theory and practice. The usual test is the tensile test that gives the tensile strength per square inch, the yield point or elastic limit in pounds per square inch, the elongation in per cent of the original gage length and the reduction of area in per cent of the original section. Compression, torsion, shock and alternating stress tests are also used and the two latter are beginning to be used much more than they have in the past because it has been found that materials may give high results in the tensile test and yet be entirely unsuitable to resist service where shock or alternating stresses are met. Another of the common tests is bending to a certain radius either hot or cold and it has been found that it is a very valuable test of certain qualities.

*A paper read before the September meeting of the Chicago Section of the American Welding Society.

Chemical analysis is another powerful method of investigation and many specifications have been made in which its use is vital.

The microscope has been found to be of tremendous help in the study of metals and, in fact it is now a necessary instrument in all laboratories. Its principal function is to determine the extent and location of impurities in a metal, to decide whether the structure is proper for the purpose desired and to decide whether various heat treatments will give satisfactory results. While no one method of test shows everything desired to be known, the microscope is probably the most powerful single method of investigation in the case of metals, and in the study of welds it is particularly valuable because of the method of their formation. A weld is a casting and is subject to all the defects found in castings, which are, however, exaggerated in the case of welds.

Fig. 1—Strained iron. The curved lines are not cracks, but the edges of parts of the grains that have slipped past each other. They are called slip bands.

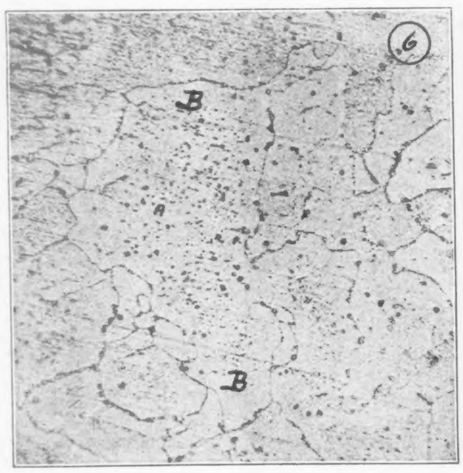


Fig. 2—A good looking oxy-acetylene weld, but made with too large a tip, as shown by the short straight lines in some of the grains.

Fig. 3—Oxy-acetylene weld showing heavy slipping at grain boundary. This is not a crack, but shows a weakness.

Welds in Steel Plates Only Considered

This paper is confined to defects in the welding of steel plate by the oxy-acetylene and metal electrode processes. The welds considered are those in some important structure where soundness and high quality are necessary. By soundness, I mean freedom from mechanical imperfections such as lack of fusion, the presence of films or other inclusions, gas pockets, slag, etc. Welds of inferior quality may answer some purposes admirably, and if they do, there is no use in making better ones, but this is not the goal at which to aim for one who desires to make really good welds. The welding of steel is frequently considered as not being especially difficult, and it is also sometimes considered that steel is steel and that no different treatment is required in the case of different qualities and varieties of steel. This idea is much less common to-day than it was several years ago, but it is still too prevalent for the good of the art. A comparatively small difference in the percentage of carbon in the material being welded makes a very great difference in the results of either a bend or tensile test. If the carbon is .12 per cent or less, the material is

soft, ductile and yields readily to any strain that may be put on it. Such material is frequently used for tanks, and because of its ductility and comparative freedom from damage by heating, is admirably suited for welding. Structural steel, bar steel and boiler plate contain about .15 per cent to .25 per cent carbon and have a tensile strength of about 60,000 lb., while the soft low carbon material has only about 52,000 to 55,000. Ship plate is required to have a tensile strength of in an oxy-acetylene weld of about 50,000 lb. Neither of these materials will weld boiler steel, boiler plate or ship plate, so that the rupture will occur outside the weld when the section of the weld is the same as the section of the piece, so that in making tests of welded pieces, it is necessary to know accurately the character of the material being welded because if Welder Jones makes a weld in soft tank steel and Smith makes one in bar steel, the first will break outside

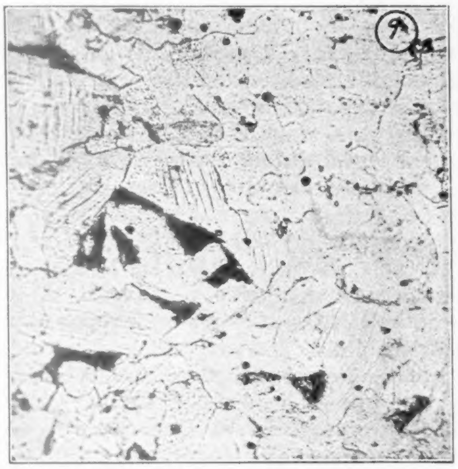


Fig. 4—Good oxy-acetylene weld made with rather high carbon steel. Note presence of slip bands as in all good welds.

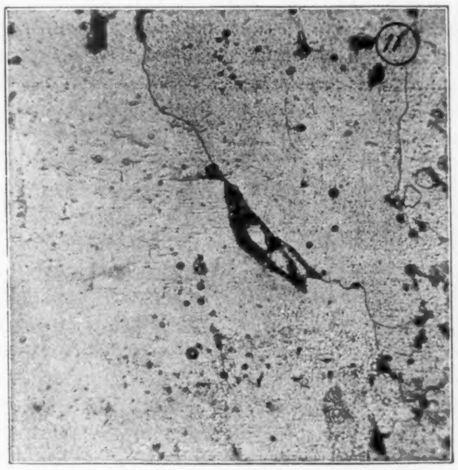


Fig. 5—Film of foreign matter, probably oxide, in oxy-acetylene weld.

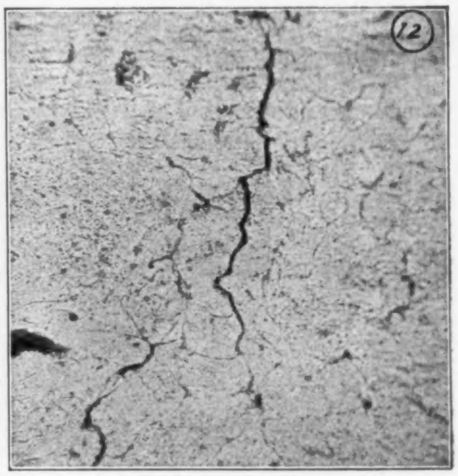


Fig. 6—Inter-granular cracks in strained oxy-acetylene weld. No defects visible before straining, showing that films were very thin.

from 58,000 to 68,000 lb. and in the heavier sections requires as high as .30 per cent carbon.

It has been found by experience that the higher the carbon the more difficult it is to get a satisfactory weld and the more danger there is of injuring the metal being welded. From a metallurgical point of view this is entirely natural and to be expected. It is also evident that a weld made with a given welding rod or electrode can have only a given strength. If this strength is greater than that of the material being welded, the test piece will always break outside of the weld and the latter in the weld with a probable adverse criticism of Smith's work.

Recommended Physical Tests

The method of test to be applied in any given case depends largely on the use to which the welded piece is to be put. If it is to be used in a pressure vessel, I believe that not only should a tensile test be made but that an alternating stress test should be used because of the breathing of the tank due to changes of pressure. This latter test should also be

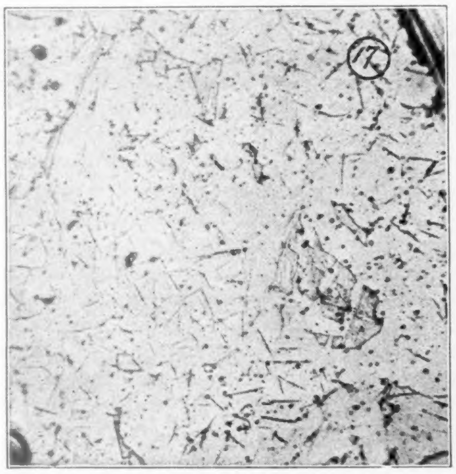


Fig. 7—Arc weld made probably with too long an arc, as there should not be so much iron nitride.

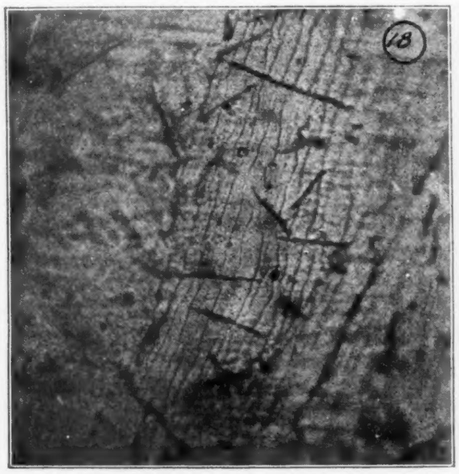


Fig. 8—Slip bands in arc weld. The heavier straight lines are iron nitride. These weaken the weld little, if any.

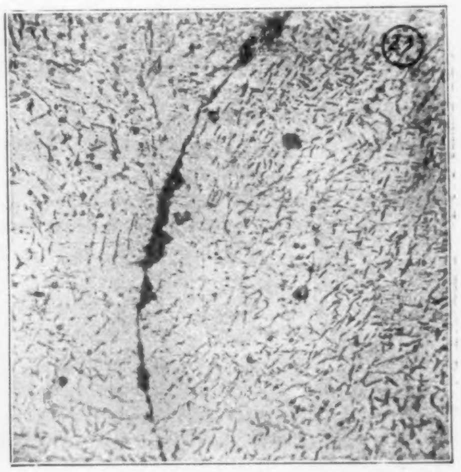


Fig. 9—Large defect in arc weld. Dark streak is oxide of iron.

weld. If, on the other hand, the weld is weaker than the material being welded, the rupture will always take place in the weld. An oxy-acetylene weld made with ordinary low carbon welding wire will have a tensile strength of about 52,000 lb. This is stronger than soft tank steel and weaker than the other materials mentioned. It is possible to get with alloy steel rods of proper composition a tensile strength applied where the weld is subjected to bending strain. There are no standards at present for weld tests, but it is advisable, whenever possible, to follow those of the American Society for Testing Materials. Inasmuch as a welded piece is not of uniform character, it is not possible to use the elongation and reduction of area as commonly measured. Where the break occurs in the weld, the elongation of the whole test piece tells.

very little about the quality of the weld, and I have been in the habit of taking the elongation in each inch, two inches, etc., of the gage length, beginning at the center inch, which includes the weld, and plotting these figures, against the gage length. Evidently, when the break is outside the weld, the various physical characteristics are those of the original material and not at all of the weld. The best test, in my opinion, to determine quickly the general charcter of a weld is to grind it off level with the surface of the pieces and clamp it on an anvil, with the center of the weld level with the top of the anvil, the bottom of the V toward the anvil so that the top of the weld is stretched when the projecting end is struck with a sledge. The blow should not be too heavy and the number of blows and angle to which the piece bends before cracking are quite a good index of the value of the weld. It is true in this test, as in the tensile tests, that the quality of the material being welded has a great influence on the results. Stiff material throws more of the strain into the weld while soft ductile material will itself take considerable of the bend. In the case of defective welds, that is, those not fused along the V or which contain slag or other inclusions, this test will at once develop the defects. If a welded piece were to be used in a place where it might become red hot, such as, for instance, in a locomotive firebox crown sheet, it would be entirely proper to test the weld at a good red heat, and I believe that it would be of much interest to all of you, if you would test some of your welds by clamping them in a heavy vise or on an anvil with the center of the weld about half an inch from the edge of the table or above the face of the anvil, heating them to a bright orange with the torch and then bending them as before with a sledge.

If such welds are made in half-inch by two-inch bar steel, a 90-degree single V being used, and they bend to a right angle cold without cracking on the outside, a welder may feel well satisfied with his work.

Conditions Affecting Quality of Welds

There seems to be quite a definite relation between the thickness of metal, the size of tip and the size of the welding wire, in the case of gas welding, and between the thickness of metal, the diameter of the electrode, and the current used, in electric welding. It is also to be understood that electric welds, except possibly those made with covered electrodes, will not stand as much bending as oxy-acetylene welds.

In many cases, the defects in welds are easily visible to the naked eye when tested. In other cases, they are not, and while it would seem plausible that the visible ones were more dangerous, yet, to my mind, the hidden danger due to the ones that are hard to see is a matter that must not be overlooked. For many years, the dangerous defects in steel rails have been those which were not visible and which have usually been very small at the start. During the war, when the demand for gun steel was very heavy, flaky steel, so called, was the material that gave the government the greatest cause for concern. In fact, those who are best posted on the metallurgy of steel are paying more and more attention to the minor defects, which heretofore have been considered but of little importance. This is equally true in a case of welds and in finding out what a welder can do, this is one of the things that should be examined most carefully. A method for testing rails for these hidden defects has recently been developed by F. M. Waring. It consists of deeply etching a polished surface of the material under test. For instance, a section of a weld might be cut out with a hack saw, machined or filed to a true surface, and polished on various grades of emery paper, ending up with 00 Manning. It is then placed in a warm solution of 25 per cent hydrochloric acid and water for from a half an hour to an hour. The acid will eat away the defects, making the edges of the material at them taper, so that rather large grooves and pits will be visible where the defects prior to the etching would be only microscopic. It is not really necessary to warm the acid, although it takes longer when it is cold. The bending test, hot and cold, and the etching test are of the greatest value in ordinary shop practice where it is desired to find out rapidly and quite accurately what the quality of the work done by the different welders is.

Effects of Strain

Some of the defects in welds are visible under the microscope, but others are not visible until the weld is strained. A small bending machine that can be placed on the microscope stage is very useful, because after etching, the piece can be bent and examined to see what the effect of the strain is. In the case of bare wire electric welds, the rupture, as far as my experience goes, always occurs at the grain boundaries, even where no defects are visible there at the highest powers of the microscope. Of course, where there are visible defects, the rupture takes place first at these. Where there are no defects, the distortion occurs by slipping in the grains as in normal steel. The causes of these defects are to my mind almost always oxides of one or another constituent of the metal, but usually of iron. There is no positive proof of this as yet, but there are indirect proofs. An electric weld that will bend very little may be made much more ductile by heating in a reducing atmosphere at a low red heat for one or two hours, indicating that the weakness at the grain boundaries has been removed. The reducing atmosphere would seem to make it clear that the material at the grain boundaries was on oxide. Again, heating an electric weld in an oxidizing atmosphere makes it more brittle.

These rough tests, while satisfactory for determining the general quality of the work, do not answer as a basis for design and more refined tests must be used as before referred to. I believe that the most important of these are the tensile and alternating stress tests.

Conclusion

A great deal may be learned from the appearance of a weld. It is difficult to describe the appearance of good welds, but after they have been seen a number of times, an inspector can readily say whether the operator knows what he is doing. In gas welding, I would not accept a ripple weld in heavy material nor one which was narrower than about 2½ times the thickness of the sheet, because I have never seen a weld having these appearances that was properly welded. The appearance of properly made electric welds has been well described by Mr. Escholtz of the Westinghouse Company and has been published in several of the trade journals. The appearance in a gas weld of porosities on top, indicates that the metal has been overheated, and the same thing is true in an electric weld. Inasmuch as I believe that the serious defects in welds are caused by oxides, it would appear wise in the case of gas welding to use no larger tip than is necessary to produce thorough fusion. This means than the catalogue speeds of welding are impossible if good welds are desired. The same thing is true of electric welds. The reason is that at the high temperatures of the steel caused by too large a tip or too heavy a current, the metal becomes overheated, and in that condition combines more readily with the oxygen of the air or with any excess oxygen in the torch flame, and produces oxides which are readily dissolved by the melted metal. As the metal cools down, these oxides are rejected in large part and pass to the grain boundaries, as do other impurities, so that it is perfectly natural that material which has been seriously overheated should be more brittle and weaker than the material which has been properly melted. I have found in a number of cases that very great improvements in the quality of the work were made by using regularly a bending test, and by carefully instructing the welders until their welds meet this test with unfailing regularity.

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LABOR SAVING DEVICES ON THE SANTA FE*

Several Effective Methods of Holding and Machining Various Locomotive Parts Are Described in Detail

BY J. ROBERT PHELPS

Apprentice Instructor, Atchison, Topeka & Santa Fe, San Bernardino, Cal.

With the present high cost of labor, it is important that every possible effort be made to simplify shop operations and increase the output. One of the best methods of accomplishing this result is to design and install efficient jigs and fixtures wherever possible, thus saving time and in many cases affording more accurate work. The following comparatively simple shop devices have worked out well at San Bernardino:

Drilling Steam Pipe Casings

Much difficulty is sometimes experienced in drilling the connection bolt holes in steam pipe casings. If the attempt is made to hold the casing on a block of wood with one hand and operate the drill lever with the other, there is a considerable chance of either the block or casing slipping with possible injury to the operator or breakage of the drill. The jig illustrated in Fig. 1 has proved both simple and convenient for this work. It consists of a framework of 1½ in.

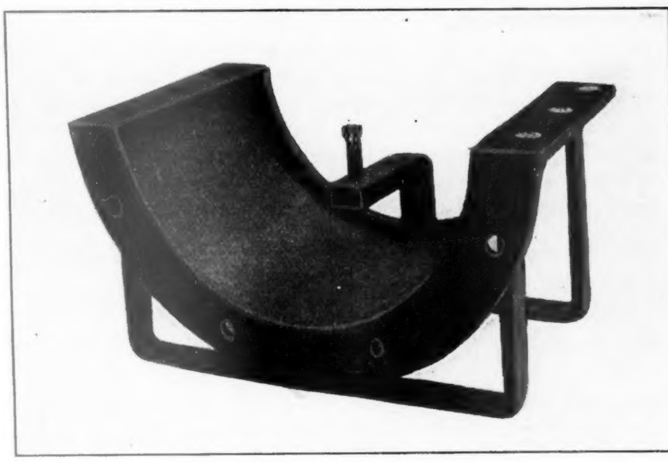


Fig. 1—Jig for Holding Steam Pipe Casings

by ½ in. iron built up by bending and electric welding and arranged to rest squarely on the drill table. It is fastened to the drill table by a ¾ in. by 2½ in. bolt and supports the steam pipe casing in the proper position for drilling. A set screw is provided to hold the casing in place. This device eliminates all blocks, bolts and clamps and is a big time saver, as the casing to be drilled needs no leveling and is quickly applied and removed.

Machining Eccentric Blade Jaws

A device which has proved useful in machining eccentric blade jaws is shown in Fig. 2. It is especially useful when the inside jaws have become worn and are built up by gas or electric welding to take up lateral play. An eccentric blade is shown in Fig. 2, set up on a millling machine table. Referring to the illustration, the Arbor *A* is turned to the standard taper of the eccentric blade pin holes, namely, ¾ in. in 12 in. The eccentric blade is set up and securely fastened to the milling machine table so that the arbor is level and square with the table. The boring bar *B*, shown in detail in Fig. 3, is provided with a cutter *C*, held in place by set screw *D*. After the blade has been securely clamped in the correct position, the arbor is removed from the eccentric blade jaws. The boring bar is placed through one side of the pin hole and both inside faces are machined with the

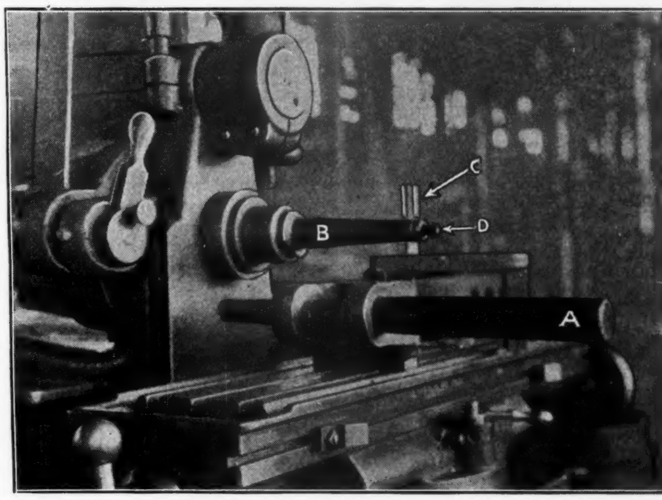


Fig. 2—Eccentric Blade Set Up on Milling Machine

double acting cutter fastened in the boring bar. In addition to getting a smooth, accurate job by this method, there is a big saving in time over the former method of performing the operation on a slotting machine. To care for eccentric

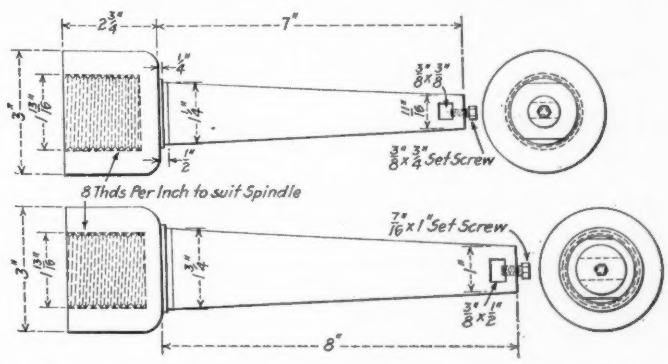


Fig. 3—Details of Boring Bars for Light and Heavy Work

blades with non-standard taper two additional arbors are provided with tapers of ⅜ in. in 12 in. and ½ in. in 10 in., respectively.

Boring Cylinder Bushings

It may sometimes be necessary to bore high pressure cylinder bushings in a lathe and for this operation some holding device must be employed. An arrangement of four iron bars, provided with set screws, and placed in wooden blocks, as shown in Fig. 4, has been found effective. The blocks are securely fastened together by iron straps and the cylinder is adjusted and held in place by the set screws. Previous practice was to bore blocks to the exact bushing size, place

*The first article written on this subject by Mr. Phelps appeared on page 721 of the November *Railway Mechanical Engineer* and described five efficient jigs and fixtures in use at the San Bernardino shops.

the bushing in the hole and clamp down the block. This practice made it necessary to have seven or eight different sizes of blocks and every time a set became warped or a

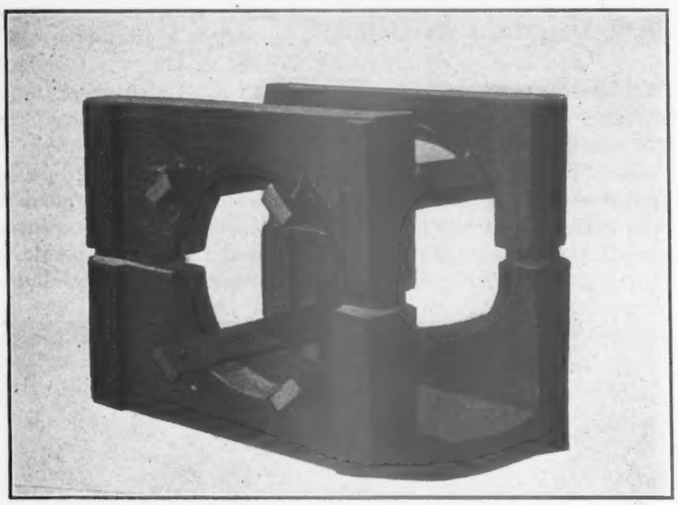


Fig. 4—Device for Holding Cylinder Bushings in Lathe While Boring

bushing varied in size, new blocks were required. By the use of the jig illustrated one set of blocks will hold every size of high pressure cylinder bushing in stock. As the bushings are now cast about eight inches shorter and without flanges, there is a saving of three hours' time and 90 lb. of cast iron on every high pressure cylinder bushing.

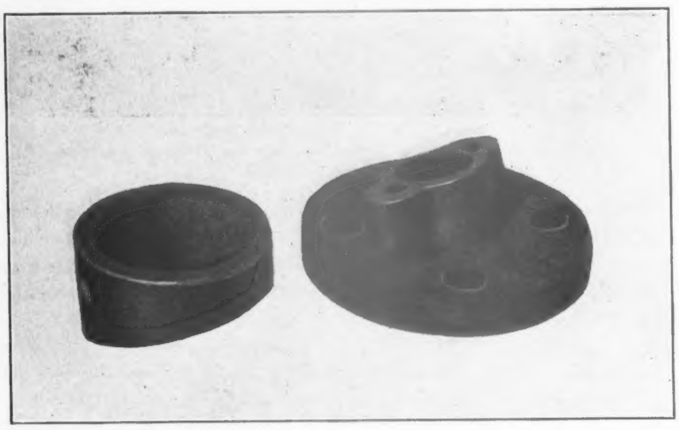


Fig. 5—Throttle Rod Stuffing Box and Jig Used in Drilling Stud Holes

Drilling Stuffing Box Stud Holes

An arrangement for holding throttle rod stuffing boxes while drilling the two stud holes is shown in Figs. 5 and 6. Owing to the slant or angle of the flange, a large amount of leveling and blocking is necessary to get the stuffing box face level; not only that, but the blocking in many cases slips out and all the time spent in leveling has been wasted. Where many stuffing boxes have to be drilled, it will certainly pay to make a special jig for holding them. The jig may be made of cast iron or brass. As shown in Fig. 6, it consists of a bushing or piece of tubing just large enough to slip on over the ball joint of the stuffing box. The bushing is cut off to a taper or angle corresponding to that of the stuffing box, an arrangement which brings the stuffing box face horizontal ready for drilling. The stuffing box cannot slide off, being held by its projecting ball joint and the entire arrangement can be held firmly to the drill table by one clamp and with no clumsy blocking.

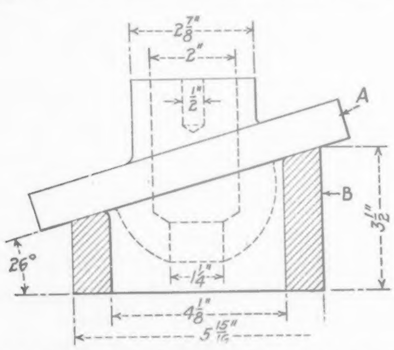


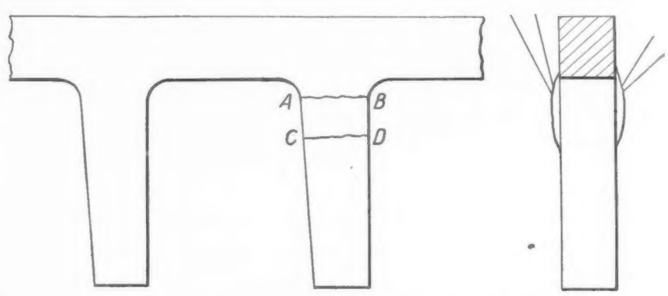
Fig. 6—Stuffing Box Set Up Ready for Drilling

BROKEN THERMIT WELD

BY J. D. SMITH

One of the back pedestal legs of a locomotive was broken at an old Thermit weld, and it was decided to repair the frame by making a new Thermit weld. It was necessary to cut out a block of steel from the leg as shown at *ABCD* in the illustration, the distance *AC* being about 3 in. and the total volume of metal removed about 48 cu. in. The surfaces *AB* and *CD* were chipped flat and parallel to the top of the frame. The Thermit box was assembled around the break and risers taken off at the inside and outside of the frame.

After the job was finished and the engine returned to service, within a few days the weld broke along the line *AB*. Upon examination of the fractured surface, it was found that the Thermit steel had not united firmly with the frame. About one-half of the area was composed of slag and blow holes; the slag, being lighter than the steel, rose to the top, and there coming into contact with a flat horizontal surface, did not all escape up the riser when the heat was poured. The other half was of a very coarse crystalline nature, brittle and easily chipped. It had the appearance of the fracture of a bar of nickel. This was probably due to the fact that the free nickel and the manganese content in the Thermit had not been properly diffused throughout the steel at the time of tapping the crucible. It was probable that the crucible was tapped before the reaction was complete. The mold was pre-heated in the usual manner, but the pre-heating was not carried so far as to bring the chipped surfaces of the frame to the fusing temperature.



Position of Weld on Pedestal Jaw

It seems reasonable to assume that had the surface *AB* been faced off at an angle with the top of the frame instead of parallel to it, and the riser taken off at the highest point, the accumulation of slag would have been avoided, as there would have been no tendency to lodge under the frame, and a better weld obtained. Along the surface *CD*, the weld was perfect, showing that the hot Thermit steel striking that part first, had thoroughly united with it. The breakage of this weld shows the importance of thorough pre-heating of the surfaces, and of allowing the reaction in the crucible to become completed before tapping. In a larger weld, the conditions are somewhat different, as a large volume of liquid steel is employed and the rate of cooling after pre-heating less.

MODERNIZING THE RAILWAY POWER PLANT

Superheated Steam and Other Means Needed to Improve Stationary Plant Capacity and Efficiency

BY R. A. HOLME
Locomotive Superheater Company

THE railroads of this country for their locomotives and stationary power plants use approximately 180,000,000 tons of coal per year, of which 20,000,000 tons, as nearly as can be estimated, are consumed by the railway stationary power plants. Figuring coal conservatively at $3.50 per ton, the value of the coal consumed in stationary power plants of the railroads for one year is $70,000,000. This enormous expense should be reduced, and with the application of possible and practical ways and means, worth while savings can be effected.

The average railway stationary power plant is subject to improvement, because outside of a few of the larger shops, equipment of old and antiquated design is being used in the smaller plants. Railway men agree that little attention has been paid to efficiency in the operation of their stationary power plants. There are many ways in which fuel can be saved in these plants. The skill and carefulness of engineers and firemen can be increased, but with the constant changes in the class of labor available, the scarcity of labor and its high wage, it is an exceedingly difficult matter to effect improvements by methods that involve the human factor.

The Government Fuel Administration as well as the Fuel Conservation Section of the Railroad Administration did an inestimable amount of good educational work among the personnel of railway officials. Great improvements resulted from these efforts, but in order to be effective this work must be continued indefinitely.

Stationary Plants Must Be Modernized

We must do more, however, than make the best of the equipment that is being used. The plants now in operation must be modernized by the installation of practical modern devices which lead to a positive increase in economy. These devices should be as far as possible inherently automatic. The utilization of modern and efficient devices will give positive and continuous improvement in fuel economy, whereas old and antiquated plants require continual expenditures to be kept in a reasonably efficient condition. The design of machinery and equipment predetermines the efficiency of a power plant. An incorrectly and poorly designed plant can never be made economical, regardless of how intelligently it is operated. It is essential therefore that all new plants built in the future be designed to give the most economical results, both in the use of fuel as well as in the training of labor.

Modern superheater equipment as applied to stationary plants should show an average saving of 15 per cent in fuel. In a 1,000 h.p. plant using 50 tons of coal a day at $5 a ton, this saving would amount to about $14,000 a year. This saving will not only pay for the charges against the investment, but will leave a substantial margin of profit.

Careful consideration should be given to the design and construction of the baffles which form the passage for the hot gases. Leaky baffles result in great waste.

The question of keeping the boilers clean is important and the installation of soot blowers can be made at a very moderate cost. Boilers should also be kept clean internally to prevent the failure of water tubes or boiler plates and to keep down the consumption of coal.

The proper amount of air required for burning the fuel dictates the correct use of dampers. A few railway plants are equipped with damper regulators and this equipment can be installed at a moderate cost. Another apparatus which results in improved efficiency and one seldom found in a railway plant is the feed regulator, which is a highly successful means toward improving the efficiency and operation of a plant.

The wonderful development in the design and construction of mechanical stokers now makes possible better regulation of the fire and higher economy by the installation of such equipment. Coal and ash handling equipment are improvements which are factors in modernizing the average railway stationary power plant, from which economy is derived.

Advisability of Using Superheated Steam

Superheating theoretically reduces the amount of fuel consumed from 6 to 15 per cent and actual tests have shown fuel saving of better than 20 per cent. Where the cost of fuel is high, therefore, superheating directly applied is a valuable and profitable investment.

The following is a comparison of the steam consumption of different types of engines using saturated steam (under average plant conditions) with those using superheated steam at 100 deg. and 200 deg. Fahr. superheat:—

Type engine	Steam consumption, lb. per hp. hr.		
	Saturated steam	100 deg. superheat	200 deg. superheat
Simple non-condensing	29-45	20-30	18-36
Simple non-condensing automatic	26-40	18-34	16-30
Simple non-condensing Corliss	26-35	18-30	.....
Compound non-condensing	19-28	15-25	13-22
Compound condensing	12-22	10-20	9-17
Simple duplex steam pumps	120-200	80-160	.....
Turbines, non-condensing (kw. hr.)	28-60	24-54	21-48
Turbines, condensing (kw. hr.)	12-42	10-38	9-34

The saving, of course, depends upon the efficiency of the engine itself, but it will be noted that in all cases superheating shows substantial steam economy. The percentage of saving varies from 9 to 33 per cent for 100 deg. superheat to from 19 to 38 per cent for 200 deg. superheat.

Another factor which should be taken into consideration in the modernizing of an existing plant by means of superheating is that of maintenance. The question of maintenance depends on the design and construction of the superheater installed. Under no circumstances should superheater equipment be installed until the existing conditions in a plant have been properly, carefully and thoroughly studied. Recommendations for superheater equipment can be made correctly only after such a study has been made. On these recommendations depend the degree of superheat which can be most advantageously used. In a properly designed superheater the maintenance of the superheater should be no higher than the maintenance of the boiler. It is well to bear in mind that the maintenance of the boiler itself is actually reduced when a superheater properly designed is installed, because superheating so increases the capacity of the boilers that in a battery of superheated boilers the added capacity may make it possible to periodically rest each of the boilers as the other boilers will still have sufficient capacity to carry the load economically. In a plant so designed and so equipped one boiler can be held in reserve, with the result that all of the boilers will last longer and their maintenance cost thereby be reduced.

The superheater equipment should be such that it can be easily maintained by the usual boiler room help and by the

use of such tools as are ordinarily found in the boiler room. It should not be necessary to go outside to secure skilled boiler makers to keep it in first-class operating condition.

Capacity an Important Factor

Not the least important of the factors which indicates the advisability of applying superheated steam is the question of boiler capacity which frequently faces railway officials. We have already seen that superheating decreases the steam consumption of the engine. This decrease may be attributed to the fact that superheating eliminates cylinder condensation, thereby insuring dry steam reaching the engine. With a decrease in steam consumption, due to superheating, a steam reserve is built up, which reserve is available and can be utilized in the engine to take care of its overload capacity, should an additional power demand be required.

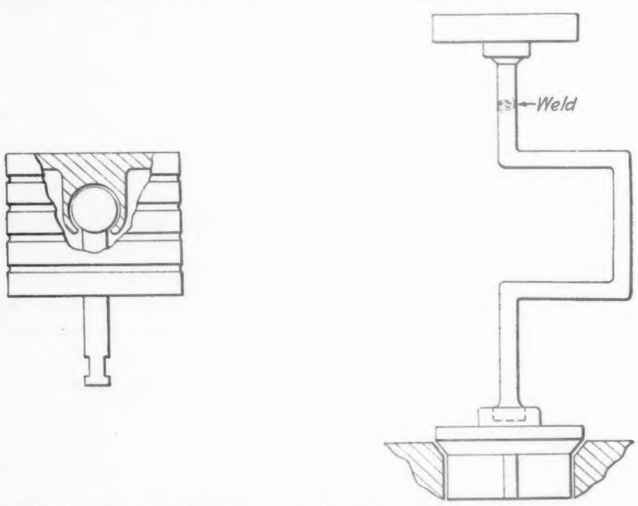
Another important factor to be considered is the course which must be pursued by the power plant operator if he is forced by boiler insurance companies to operate his boilers at a lower pressure. The logical result of such pressure reduction is the loss of capacity of the plant, necessitating the possibility of adding another boiler to make up for the loss. Because superheating makes up the loss in boiler capacity caused by the reduction in the pressure, it is a convenient, satisfactory and inexpensive method to overcome the difficulty which obtains in many power plants. Furthermore, the plant operating on superheated steam will furnish more power even under a reduced pressure than it will if it were using saturated steam; in other words, superheating will enable a plant to operate economically and at its original capacity at a reduced pressure.

Long steam lines in many cases have illustrated that the problem of condensation is a serious one and the necessity for reducing this condensation is frequently a vital factor. With superheat, therefore, it may be possible to raise the temperature of the steam to a point where all of the steam can be transmitted to its destination without condensation losses.

HANDLES FOR GRINDING BRACES

BY F. W. B.

Homemade valve grinding braces vary in size and nature to suit the work they are used on, but the handle is usually a troublesome part. The sketch illustrates how a desirable handle can be made from a scrap air motor piston. Discarded pneumatic motor pistons are of all sizes and it is not much trouble to anneal a number of them, cut away some of the wing making a solid durable handle grip that will stay on and run smoothly. The end of the piston rod can be welded to the brace quickly with an acetylene torch.



Grinding Brace Handle Made From Scrap Air Motor Piston

HOW TO MAKE A GOOD CHISEL*

A large number of the chisels now in use are not forged, shaped and hardened in the best way to give long life and adequate service. Considering the making of a chisel from ¾-in. octagon tool steel, the following method has been found to give good results.

Forging

Cut off a length of steel, depending on the length of chisel desired, and heat up the end for 2 in. to a bright cherry red. Trim off two opposite sides so as to form a blunt nosed tool and eliminate the danger of lapping when drawing out. The horn of the anvil should be used in drawing out, inasmuch as this will have the least possible tendency to widen the piece, and therefore the minimum amount of "edging in" or hammering on the edge will be necessary. A chisel should not be hammered on the edge because the grain of the steel will thereby be distorted or "crumpled up," and this always has a tendency to weaken any metal. If in the final forging operation the chisel gets a little too wide, it can be trimmed off on the emery wheel during the grinding operation.

Draw the chisel out so that it will be about ⅛ in. thick at the end and about ⅜ in. thick and 1¼ in. back from the end. The forging should be finished with light blows until the steel has almost lost color, but it absolutely must not be struck after the color has disappeared. It is good practice to reheat the steel to a dull red without using any blast, and give it a second hammering with light blows until the color has again almost disappeared.

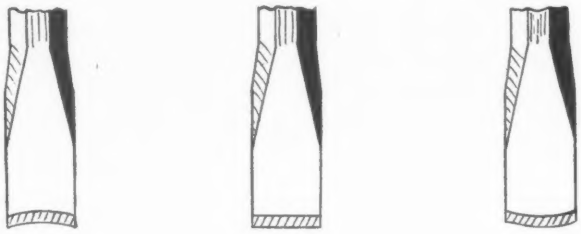


Fig. 1 Fig. 2 Fig. 3

Three Methods of Grinding Flat Chisels

The four important things to remember in forging a chisel are, therefore: Draw out at a good cherry red heat; finish with light blows at a dull red heat; do not hammer after the color has disappeared; hammer as little as possible on the edge and then only when the steel is fairly hot.

Grinding

Grind the chisel before it is hardened, as it can be ground faster in this way without the danger of drawing the temper. The shape of the edge of the chisel is very important, although this fact is often overlooked. Fig. 1 shows a chisel ground with a concave edge. If this is driven down onto a flat surface, it is obvious that a great strain will be put on the corners, and they are almost sure to break off. Fig. 2 shows a chisel ground with a perfectly flat edge. If this chisel is driven down onto a flat surface and held perfectly straight the cutting strain will be distributed evenly over the entire edge, and the chisel will be satisfactory. It must be remembered, however, that it is almost impossible to hold a chisel absolutely straight and, therefore, either one corner or the other will be severely stressed by the chisel being tilted over. Fig. 3 shows a chisel ground with a slightly convex edge, which is by far the best for ordinary work. The corners of a chisel are always the danger point, and with the convex edge these

*Abstract of 4-page folder issued by Joseph T. Ryerson & Son, Chicago, Ill., entitled "Do You Know How to Make a Good Chisel?"

corners are protected even when the chisel is tilted over considerably to one side or the other.

Hardening and Tempering

After the chisel has been ground to the desired shape, heat it to a dull cherry red color for about 2½ in. from the end and quench it vertically in cold water to a depth of 1¼ in., moving it up and down until no red color is left in any part of the steel. The part which has been drawn out should now be polished with emery cloth and the temper drawn to a dark purple or a blue by holding the chisel over the fire or in a furnace. Always draw a chisel a little more in winter than in summer. It has been recommended to harden the chisel back much further than usual because a chisel so made can be ground a great many times without redressing. Inasmuch as grinding is cheap and redressing is expensive, considerable loss can thereby be avoided.

FOUR FRAME WELDS IN TWO OPERATIONS

An interesting example of the possibilities of Thermit welding was afforded recently by an accident which happened to Baltimore and Ohio locomotive No. 4010 used in hill service. While pushing a heavy train up grade all four

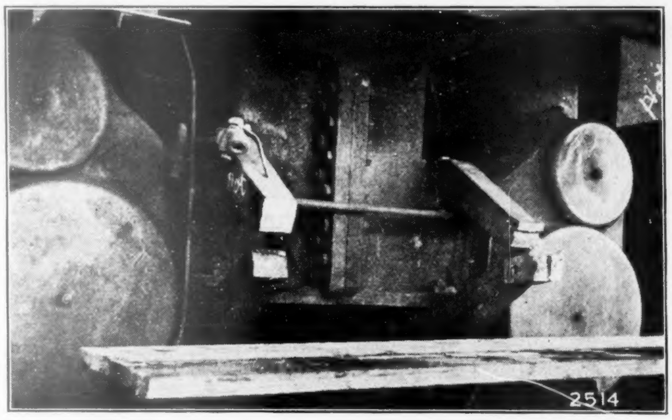


Fig. 1—Appearance of Front Frames Before Welding

front frame sections were broken in front of the cylinders as shown in Fig. 1.

In making repairs, the frames were straightened and the broken ends located in place ready for welding by the Thermit process. As the two pairs of fractures happened to be very

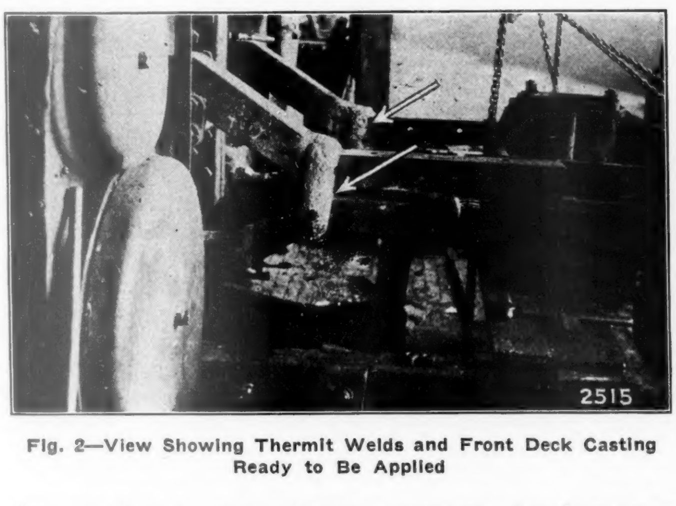
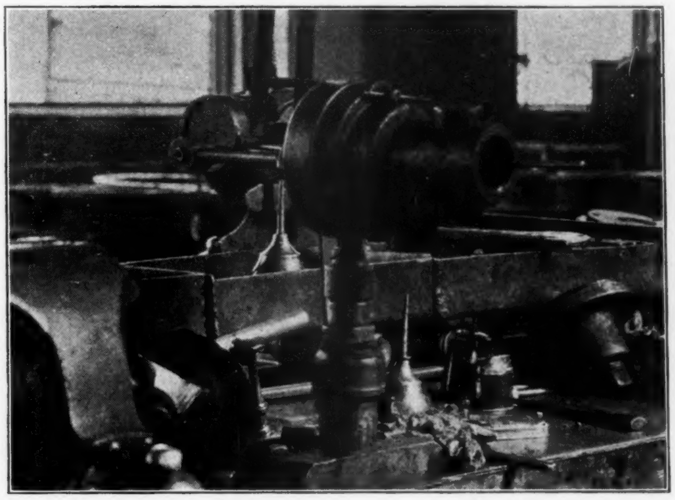


Fig. 2—View Showing Thermit Welds and Front Deck Casting Ready to Be Applied

close together, the top and bottom members of each set were repaired by making only one weld, thus joining both frames together as shown at the arrows in Fig. 2. The result was not only a saving in time, labor and material, but a strengthening of the frames at the points welded. After the welds were completed and the deck casting put in place, it was only necessary to ream out the holes and rebolt the casting. These welds were made by J. W. Boyd on April 6, 1920, and the locomotive has since been in constant service.

TRIPLE VALVE GRINDING MACHINE

The device illustrated was designed to eliminate the labor of grinding triple valve slide valves. As shown, the valve is arranged to be held on a stand on the air brake bench. The grinding compound is applied to the slide valve and it is then placed in position on the valve seat. An eccentric with a crank arm and crank is driven by means of a light



Triple Valve Grinding Machine

belt from overhead shafting. The crank arm is arranged to be connected to the slide valve and when power is applied, the valve will be moved back and forward.

When either the slide valve or its seat is badly worn, experience has shown that a long time is required to grind out the irregularities by hand. The slide valve grinding device illustrated has proved a labor-saver for this operation.

CARBON AND HIGH SPEED STEEL*

BY J. PURCELL
Western Pacific

When designing or making a tool from carbon steel we must first consider the proper kind of steel to use and then see that the tool is designed so that it will harden properly without breaking.

Too much cannot be said about the heating and forging of steel, as the heating of steel to forge is one of the most particular of all the operations. The tool dresser must turn the steel over in the forge or furnace to see that it is heated evenly to a little above the hardening temperature, say about 1,475 deg. to 1,500 deg. F. The tool dresser must bear in mind not to forge steel after the forging heat is gone, as the steel will develop small cracks and bad forging strains, which will cause it to crack in hardening.

I consider it good practice to first anneal the rough forging, then have it rough machined and then re-anneal it to take out all possible forging strains; then the tool must be machined to finished sizes. It is then ready for hardening.

In heating any ordinary carbon steel tool to harden, care must be taken not to apply heat too quickly, as this will result in cracking the tool while it is cooling in the hardening

*From a paper presented at the convention of the Master Blacksmiths' Association.

bath. A good practice is to have tools that you are going to harden placed around the forge fire, or, on top of the tool furnace, where they will become slightly heated before they are put into the fire. The tool must have time to heat to the center, otherwise it will crack when it is removed from the hardening bath. A good hardening heat for carbon steel is from 1,400 deg. to 1,450 deg. F.

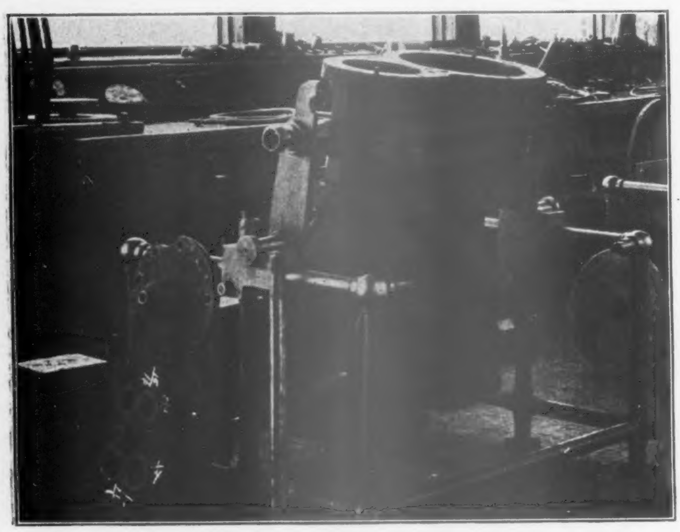
There are various ways to temper, but we use the oil and thermometer. The tool is placed in the bath of oil, which has a thermometer attached and the bath is placed in the furnace. The oil is brought up to the required temperature, the tools are removed from the oil and put into a vat containing lye to remove the oil, then quickly removed from the bath and allowed to cool in the open air. We draw the temper from 380 deg. to 590 deg. F., according to the amount of carbon in the steel.

The forging, hardening, and tempering of high speed steel is carried on by practically the same methods as carbon steel, except at a much higher temperature. We forge our high speed steel between 1,875 deg. and 1,925 deg., harden between 2,300 deg. and 2,350 deg. F., and let the temper down to about 600 deg. F.

AIR COMPRESSOR STAND

All shop men are familiar with the difficulty of handling air compressors, especially the heavy Westinghouse cross compound compressors. Many different kinds of tables or stands have been devised for holding them while under repair and the one illustrated has proved both simple in construction and efficient for this purpose.

As shown, the stand itself is composed of built up sections of pipe. Two iron brackets are arranged to be solidly fastened, one on either side of the compressor, by means of pipe studs in the air and steam intake and exhaust passages. On each bracket there is a projecting center arranged so that



Stand Arranged to Swivel Air Compressor

both the compressor and brackets will be suspended at the center of gravity of the compressor. By this means, a compresson can be easily swiveled at any angle, or upside down, whichever position is most convenient for the workman. Dogs are arranged to hold the compressor firmly in either the horizontal or vertical position.

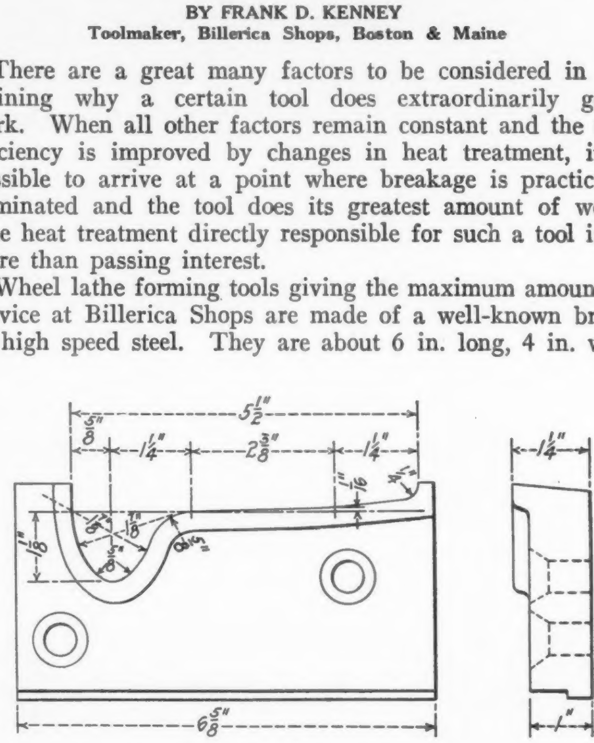
In operation, the compressor is first thoroughly cleaned and the brackets put in place. A monorail crane then lifts the compressor and brackets, setting them down at whatever compressor stand may be vacant. In this way, practically no trucking by hand is required and there is a big saving in labor.

HEAT TREATMENT OF FORMING TOOLS FOR WHEEL LATHES

BY FRANK D. KENNEY
Toolmaker, Billerica Shops, Boston & Maine

There are a great many factors to be considered in explaining why a certain tool does extraordinarily good work. When all other factors remain constant and the tool efficiency is improved by changes in heat treatment, it is possible to arrive at a point where breakage is practically eliminated and the tool does its greatest amount of work. The heat treatment directly responsible for such a tool is of more than passing interest.

Wheel lathe forming tools giving the maximum amount of service at Billerica Shops are made of a well-known brand of high speed steel. They are about 6 in. long, 4 in. wide



Wheel Lathe Forming Tool

and 1½ in. thick. On one of the 6 in. sides, a profile of the tread and flange of the tire is milled. The other long side is shouldered in about ¼ in. leaving a square rib on the lower edge which fits into a slot on the tool post. Two holes are drilled in the proper places to allow for bolting to the machine.

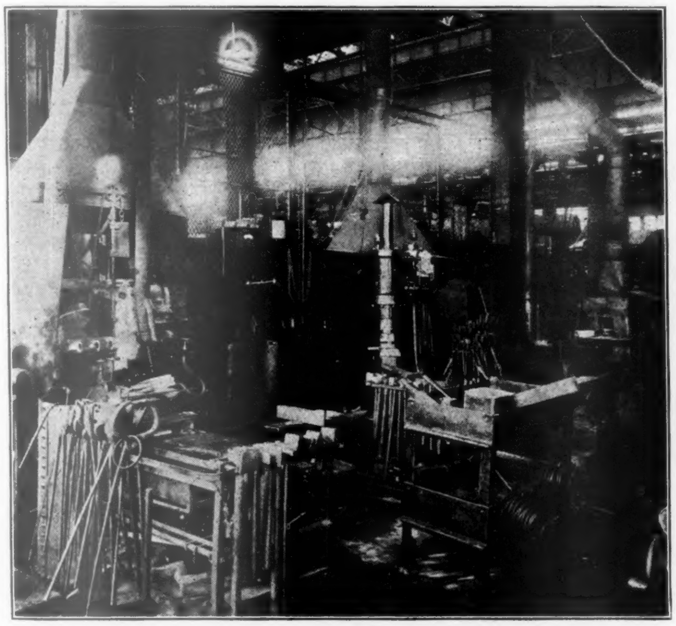
For the heat treatment of these tools, the one thing that is necessary is equipment. Not necessarily expensive equipment but efficient equipment must be provided if it is desired to obtain good results, and duplicate them to any degree of accuracy. For heat treating forming tools, four crude oil-fired furnaces, pyrometers, thermometers, etc., are used. The larger of the furnaces is held at a heat of from 1,400 deg. F. to 1,450 deg. F. and used for carbon steel; also for pre-heating high speed steel. Adjacent to this is the high heat furnace for the hardening of high speed steel, held between 2,250 deg. F. and 2,300 deg. F. Then there is the lead bath which is held at about 750 deg. F, and used for both quenching and drawing forming tools among other operations. Finally there is the tempering furnace used in drawing operations up to 600 deg. F.

Forming tools come to the tool room for treatment in pairs, a right and a left. They are laid on the roof of the carbon steel furnace and left there until too hot to handle with the hands. They are then removed to just inside the door of the 1,450 deg. F. furnace, which spot happens to be the coolest place within the oven. After becoming warm, they are gradually worked toward the center of the furnace. When the steel becomes thoroughly heated to the temperature of the oven, the tools are ready for the high heat. They are placed in the 2,300 deg. F. furnace one at a time, each tool being constantly watched and frequently turned and moved about to insure uniform heating. When the last "shadow" has left the center of the tool, and the surface looks glossy and wet, and when little bubbles seem about to form, or in other words when the tool attains the proper hardening temperature, it is removed and placed in the lead bath which has been previously heated to 750 deg. F. and quenched therein.

On account of the lead having a higher specific gravity than steel, the tool must be weighted to keep it wholly immersed in the bath. This is done for the want of a better way, by means of a heavy block of iron long enough so that one end rests on the edge of the pot and the other on the tool which is dipped endwise. This added weight keeps the tool covered with lead. The use of the lead as a quenching medium positively eliminates breakage, a fact which in itself is reason enough for its use. The second tool which was left in the 1,500 deg. F. oven goes through the same operation and both are left to cool to the temperature of the lead.

In drawing, we take advantage of that phenomenon in high speed steel treating known as secondary hardness or the 1,100 deg. F. draw. The pot is heated slowly to between 1,050 deg. F. and 1,100 deg. F., and the tools are allowed to soak at this temperature ten or fifteen minutes, after which they are removed and allowed to cool naturally. Care must be taken not to heat the tools about 1,100 deg. F., as beyond this point there is a sharp loss of high speed steel's greatest asset, that of red hardness.

The one bad feature of lead as a quenching medium is the fact that it has a tendency to stick to the work with the resultant glazing of emery wheels and trouble in general trying to get it off. This can be overcome to a great extent by using



Heat Treating Corner of Toolroom

a piece of oily waste which, if rubbed briskly over the tool immediately after leaving the bath, will remove most of the lead. The two points of the operation that must be most carefully observed are the above mentioned caution of not drawing above 1,100 deg. F., and the temperature at which the tools are quenched. Subsequent operations all depend on the quenching temperature and, of course, are of no value without the proper hardening to begin with.

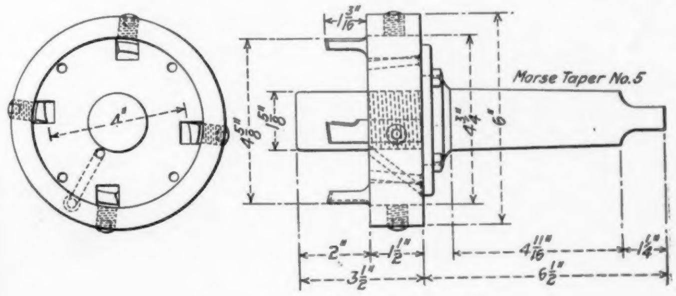
In regard to the 1,100 deg. F. drawing temperature, some very definite conclusions may be drawn from a paper prepared by the chief metallurgist of a leading machine tool manufacturer. From each of twelve different brands of high speed steel used in a test, four milling cutters were made. These were all heated and quenched alike (heated to 2,300 deg. F. and quenched in oil at 100 deg. F.). Two of the cutters from each brand were drawn to 450 deg. F., and the remaining duplicate set was drawn to 1,100 deg. F. A comparison of the hardness numbers made before and after the 1,100 deg. F. draw showed that two of the steels actually gained in hardness. Probably the most valuable data given was that made while the tools were checked under actual working conditions, which is in the last analysis the only real test of a tool. Tools drawn to 1,100 deg. F. in every case gave greater production than the ones drawn to 450 deg. F., and in some cases two or three times as much. These final phases of the experiment prove conclusively the great value of secondary hardness.

FLUE HOLE CUTTER

BY A. G. JOHNSON
Mech. Engr., D. & I. R., Two Harbors, Minn.

The illustrations show a special cutter used to make holes in firebox flue sheets for superheater flues. It is also adaptable to cutting holes in front flue sheets which, however, seldom need to be renewed. The cutter is used in a heavy drill press or radial drill.

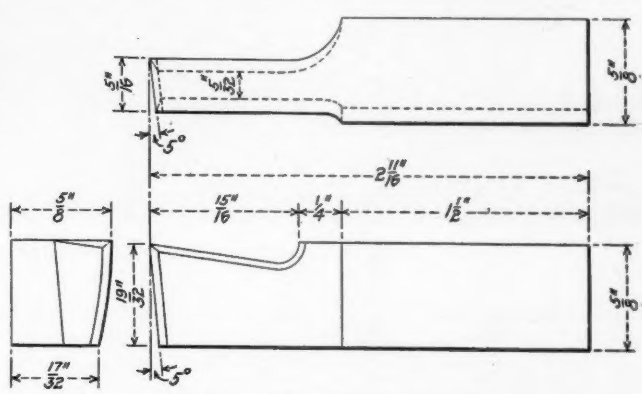
The shank is turned to a number five Morse taper and the



Assembled Flue Hole Cutter

guiding end is made of tempered tool steel. The center piece is a piece of soft steel, screwed onto the shank. Square slots are milled so that the cutting edges of the tools will come exactly on the center lines. The finished ring is shrunk on, then drilled and tapped for the safety set screws.

The cutters, which are made of ⅝ in. square tool steel, are held in place by the safety set screws shown and a plate is fastened on the back to prevent them from coming out. The tools are now dressed up on the grinding wheel and turned inside and out, with the grinder, to the exact size circle

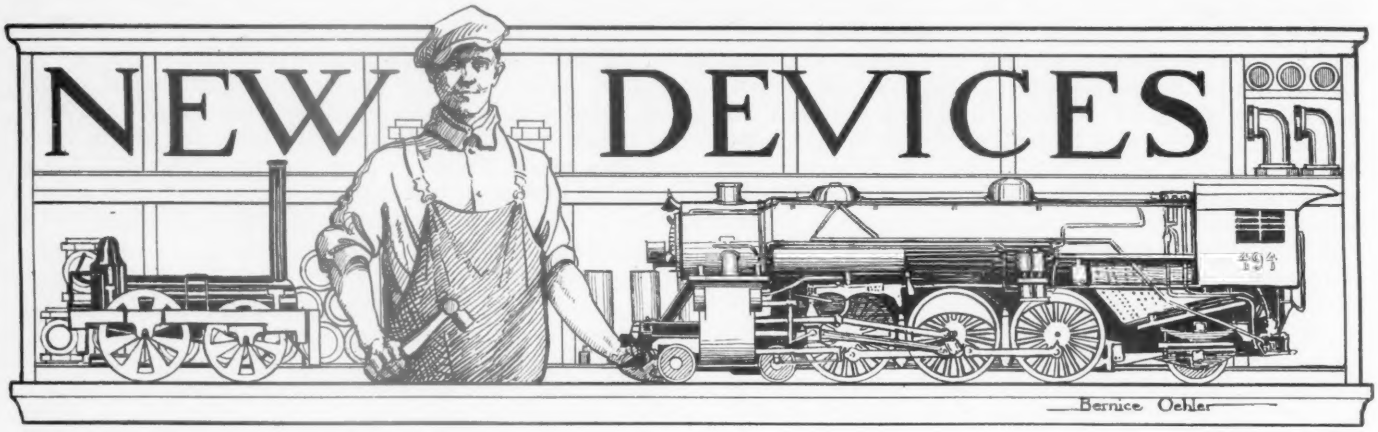


Sketch Showing Cutter Details

required. It will be noted that two tools are ground to cut on the outside and the remaining two are ground to cut on the inside so each continuously leaves clearance for the other, which makes a smooth job. Oil holes are put in, one for each tool and one for the center pin.

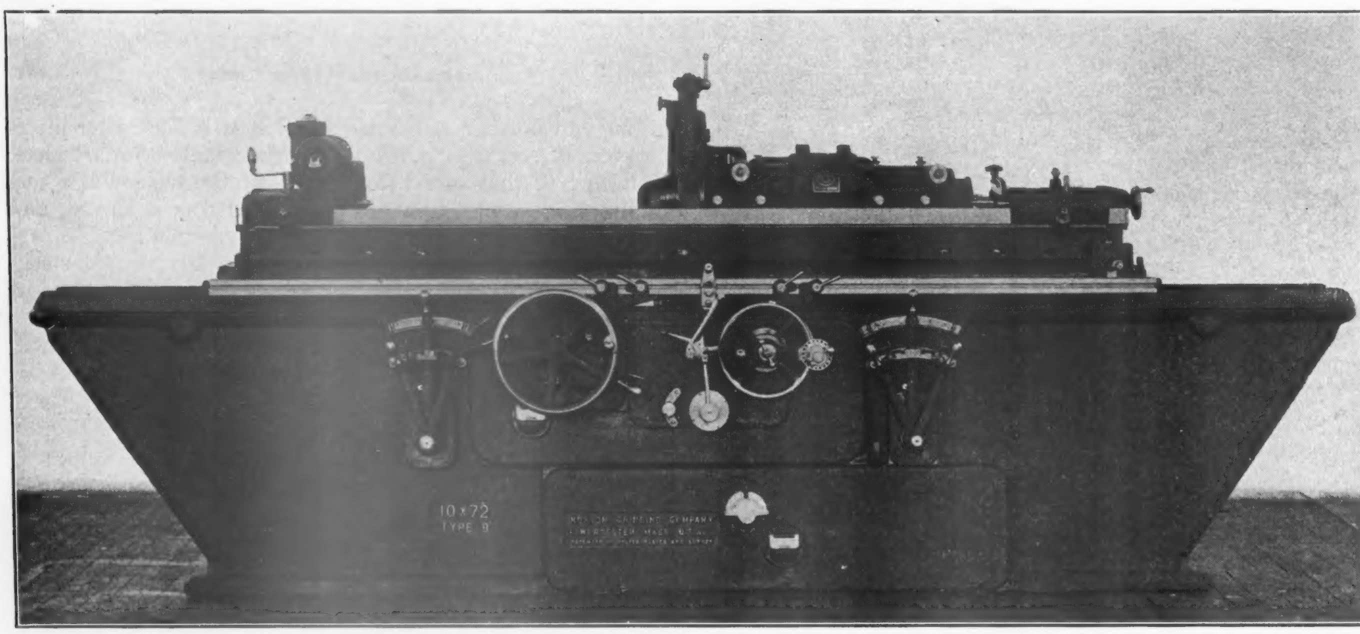
In operation the sheet is first layed out and flanged, the centers for flue holes being drilled 1⅝ in. in diameter to guide the cutters. Finished holes are cut in the sheet, at the rate of one every five minutes, through a ½ in. sheet.

One hundred and ninety holes have been cut through ½ in. plates with one set of tools without regrinding.



Self-Contained Cylindrical Grinding Machine

A NEW cylindrical grinding machine developed by the Norton Company, Worcester, Mass., embodies two important departures from previous practice. The new machine, known as the 10-in. by 72-in. Type B grinder, is entirely self-contained, being arranged for electric motor drive with the motor an integral part of the machine. This eliminates all overhead shafting and belts. The second noteworthy feature is the table speed obtained. In the past, it has been difficult to obtain a table speed of over 10 ft. per min. but by means of a patented reversing mechanism which reduces the shock and noise at reversal, the new Norton grinder provides table speeds from 10 to 32 ft. per min.



Norton Type B Cylindrical Grinding Machine of 10-In. by 72-In. Capacity

The head stock work drive is by means of spiral and worm gearing entirely enclosed in oil. The rotation of the work is started or stopped simultaneously with the table or alone by the use of a quick-acting lever and a multiple disc clutch. The footstock of the grinder is of improved construction combining the screw and lever types. Adjustment for the spindle fit can be made over its entire length at any time.

The wheel head or wheel slide is of massive construction and hollow containing a chain-driven pump and oil reservoir for oiling the wheel spindle and end thrust bearings. The oil supply to the spindle bearings is visible through two glasses in front of the operator. The spindle bearing adjustment is simple and the operator can cause the bearings to close tight upon the oil film on the spindle by simply turning the thumb screws until he cannot turn them any more. This adjustment is made at any time while the spindle is running. The end thrust also is adjusted by a thumb screw.

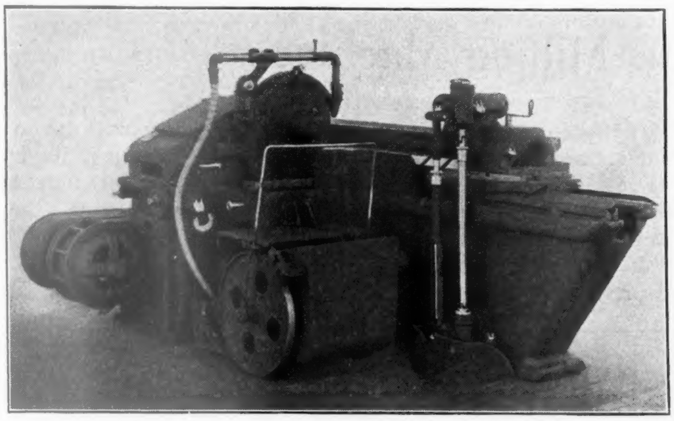
The spindle is driven by a belt from the power shaft enclosed in the base. Owing to the belt pull being downward instead of up, it is possible to transmit a greater amount of power to the wheel spindle than in former drives. An idler is provided to take up slack in the belt.

The work table is of improved construction to secure neatness in the care of the grinding compound. The sliding table is started and stopped either simultaneously with the work or separately as desired. The speed changes for the table are transmitted by means of heat-treated sliding gears and positive clutches in an oil bath. There is an independent table speed for truing the wheel which is obtained by moving a lever for this purpose only. The proper speed is obtained at once regardless of which work traverse speed may be in gear and is returned to the original table speed by moving the same lever back.

A quick-acting hand cross traverse for the wheel slide

and an improved micrometer adjustment for sizing work are provided. The in-feed is operated either at each end of the table stroke, or when the table is still for a direct in-cut. The change is made by the simple movement of a lever.

The pump tank and settling tank are integral, mounted

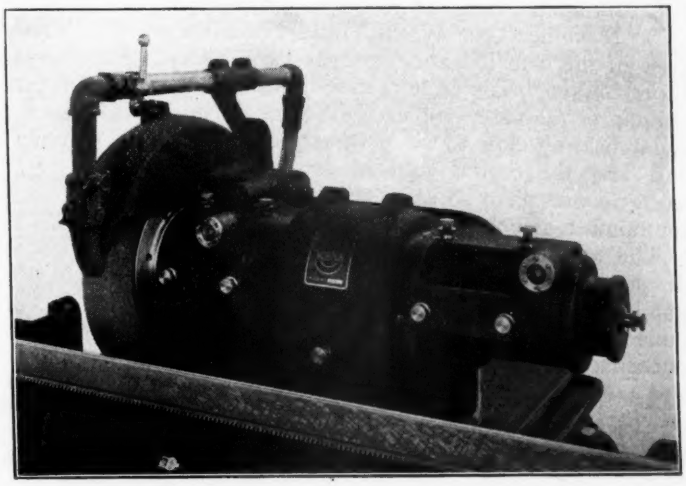


Rear View of Grinder Showing Setting Tank, Headstock Drive Mechanism and Driving Motor

upon ball-bearing truck wheels, so that the tank is in reality a dump cart on wheels. The pump is arranged to swivel on its driving-shaft axis and can be swung up out of the tank and the tank removed to dump while a duplicate filled with clean compound is rolled into place. The time required for changing the tank is only from three to five minutes. The steadyrests are of improved construction. They have thumb-screw stop adjustment for size of work and are attached or detached quickly by a lever and cam. The work shoes and work-shoe holders are interchangeable with previous types of Norton grinding machines.

Special attention has been paid, in the designing of the machine, to the lubrication of bearings. With the exception of a few places where it is not essential that the oiling be frequent, all the bearings are automatically oiled. There are also 47 ball bearings throughout the machine, all of which are enclosed in oil baths.

Six work speeds are provided ranging from 53 to 167 r. p. m. There are seven speeds for the work table. A truing speed of 2.3 ft. per min. can be obtained and regular speeds vary from 10 to 32 ft. per min. The length of the table is 8 ft. 10¾ in. Cylindrical work 72 in. long and up to 10 in. in diameter can be ground. Each tooth in the

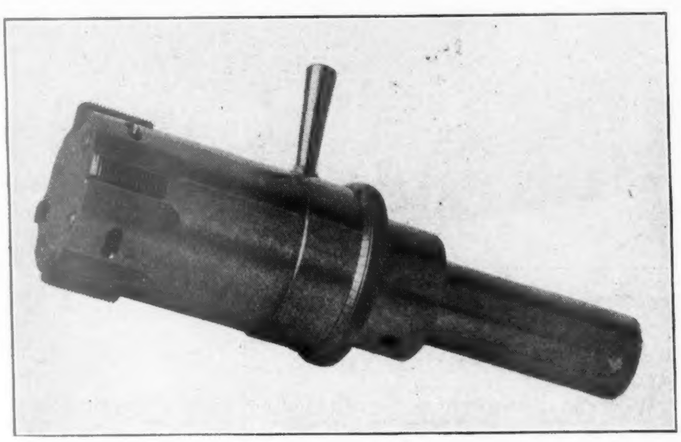


View of Wheel-head Showing Bearing Adjustment Screws

index gear represents a work diameter reduction of .00025 in. and there is an automatic feed range from .00025 to .0035 in. diameter reduction at each reversal of the table. A 15-hp. motor, designed to operate at a constant speed of 1,200 r. p. m., is required to drive the new Norton grinder.

Collapsible Tap of Simple Rugged Design

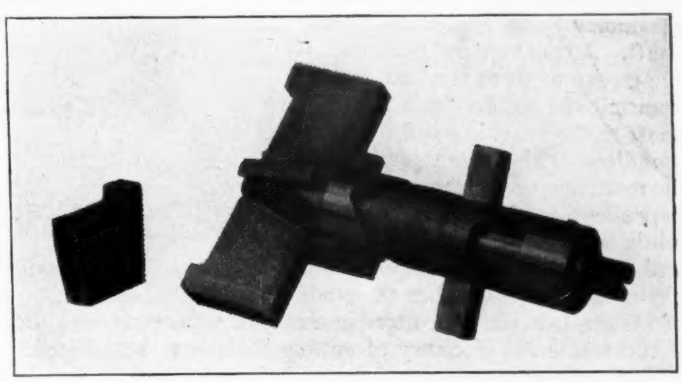
THE original and outstanding feature of the new collapsible tap, made by the Rickert-Shafer Company, Erie, Pa., is the method of withdrawing the chasers when the work has been tapped to the required depth. The manufacturers claim it to be positive in action, inasmuch



Rickert-Shafer Collapsible Tap

as it is impossible for it to stick. This is a decided advantage in all cases, but especially so where work has to be tapped close to the bottom of the hole, in which case the operator can place full reliance upon the tool, as it is stated that the chasers will be released at exactly the right point.

The illustrations show the manner in which this is accomplished. At the point of release the force of the cut pulls the head from the locking pins and revolves it. This action causes the cams on the core to act and pull the core back, drawing the chasers in the head and clearing them from the



View Showing Mechanical Details of Collapsible Tap

work. It will be seen that in this tool no dependence is placed upon springs for the purpose of collapsing.

Attention is also directed to the method of making adjustments, which allows these to be made to the fractional thousandths. A guarantee accompanies these taps that they will

hold to size, within the most exacting limits, and that sizing hand taps can absolutely be dispensed with.

These tools have hardened and ground wearing parts and scientifically accurate chasers. They are manufactured in sizes from 1 in. to 10 in., or larger, and can also be combined with boring, reaming or chamfering tools, thus greatly increasing production by eliminating additional operations and set-ups.

Heavy Duty Continuous Milling Machine

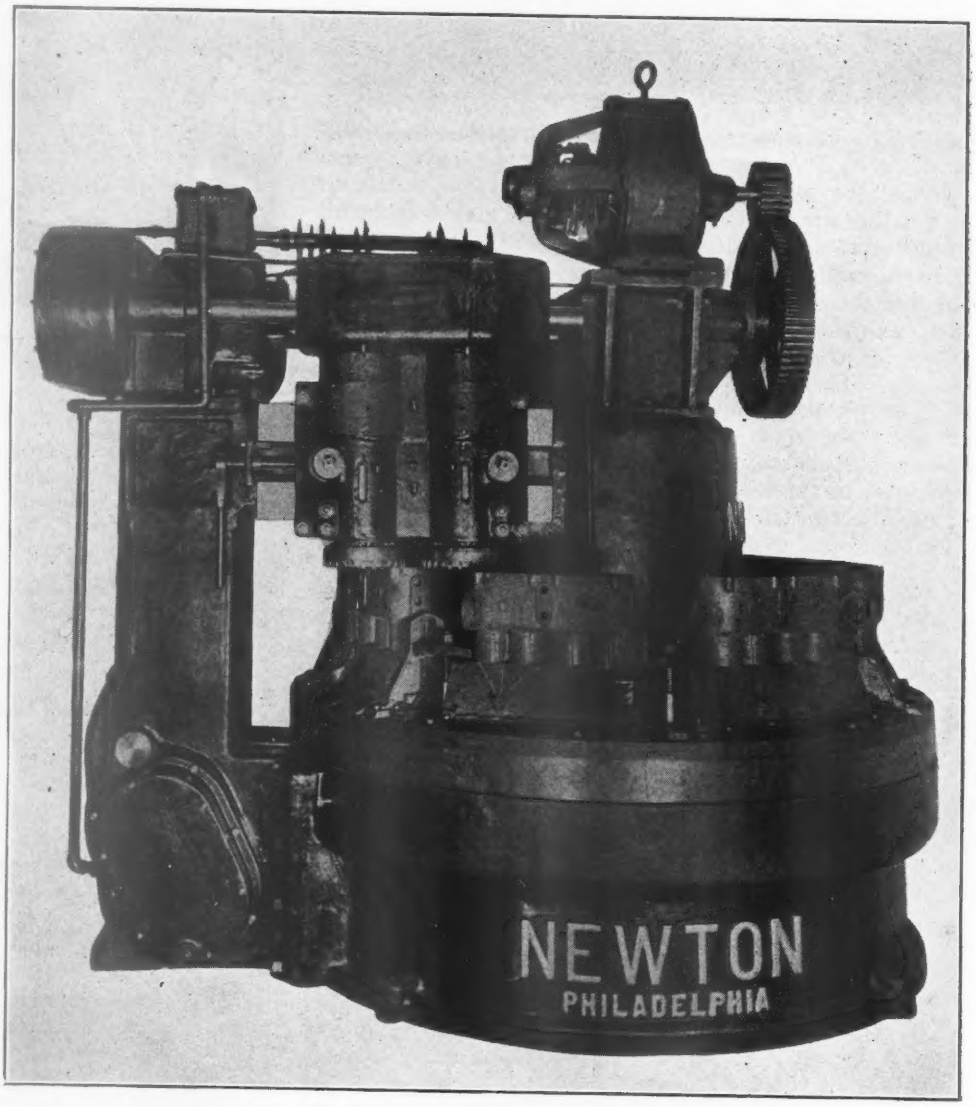
The continuous milling machine of the ring table type illustrated herewith has been developed by the Newton Machine Tool Works, Inc., Philadelphia, Pa. The base of the machine is circular in form, providing a central taper column. The table casting is fitted to the central taper column of the base, and in addition is provided with an annular bearing close to the periphery of the table. The cross rail and the central upright are made in one piece so as to reduce the number of bolted connections.

The machine table is 84 in. in diameter and the depth from the annular bearing to the top of the table is 12 in. The least diameter of the taper fit between base column and table is 36 in. The table is provided with a finished hub 42 in. in diameter to assist in locating jigs on the table. The central column is bolted and keyed to the base and the cross rail is fitted in the front with one housing containing two spindles for the roughing cut. On the back of the cross rail and at a distance of 42 in. is a similar housing carrying a single spindle for the finishing cut.

Both housings for the roughing and finishing spindles can be positioned on the cross rail so that, where the machine is used for a variety of work, the spindles can be positioned to the most economical location of the jigs upon the table. The outer end of the cross rail is supported by a column which is bolted and doweled to the base as well as the cross rail. Motor drive is provided on top of the machine, the motor being geared to a jackshaft. At the extreme outer end of the cross rail there is a box used to transmit the motion from the jackshaft to the roughing and finishing spindles. This permits of varying the rotative speed of the spindles independently of each other and, while the speed is predetermined and fixed, this provision permits of changing the speeds when the grade of material or size of cutters is changed, a necessary feature if the maximum efficiency of cutting tools is to be utilized.

The rotative movement of the table is controlled by a fixed feed which is predetermined, but can be changed to suit any change in the grade of material. There is not, however, any possibility of the operator increasing or decreasing the production of the machine as the rotative speed has been predetermined. This means that a given number of stations per hour must pass the loading station, hence that number of pieces must be machined or require an explanation.

The table itself is rotated by a herringbone gear 81 in. in diameter. Each of the spindles is provided with an individual adjustment for setting the cutters to gages. Different sizes of housings providing varying centers between the roughing spindles are used, depending upon the dimensions of the work. Generally, however, these centers are either 12 in. or 14 in. Both spindles are rotated inward or clockwise on the left hand spindle and counter clockwise on the right hand spindle.



Newton Ring Table Type Continuous Milling Machine

With the distance of 42 in. from the center of the roughing cutters to the center of the finishing cutters, it is quite clear that the roughing operation has been performed on a given casting before the finishing operation commences, hence the finishing cutter is relieved of any influence on the part of the roughing operation and, due to the slight cut taken by the finishing cutter, any inaccuracy resulting from either dull roughing cutters or inequality of castings is picked up by the

finishing cutter, insuring accuracy of both finish and dimension. The principle of roughing and finishing cuts permits of operating at much higher cutting speeds and table feeds than is practical by any other process of surfacing operations.

All bearings, except the spindle bearings, are oiled by the cascade method of lubrication. Oil is pumped from a reservoir in the outer upright to the box on top of the machine, from which point it is distributed.

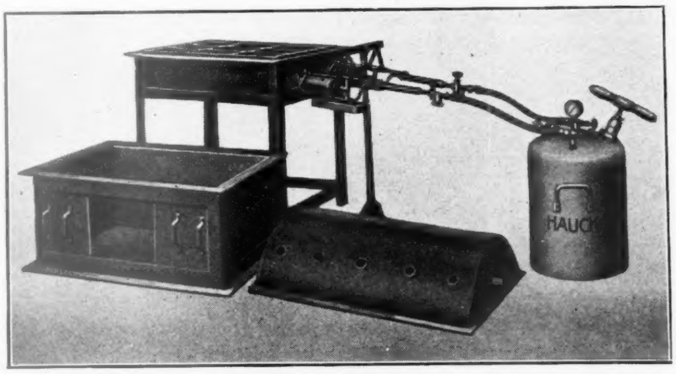
An important element is the extreme ruggedness of all operating parts and an excessive amount of weight is provided in view of the fact that the parts machined are quite incapable of absorbing any of the vibration set up by all cutting actions. The machine is designed to absorb and dissipate such vibration. The character of the work usually presented to these machines does not require a great range of adjustment, hence with the standardized model, this is taken up, first, by the adjustment in the spindle heads and second, by variation in the height of the jigs themselves.

The work presents itself to the cutters at varying angles providing that shearing action which it is recognized gives the best cutting results. Also the inner or right hand cutter is further advanced than the left hand cutter. This is a good feature because the cutters are not on a radial line, hence the inner cutter does cut considerably in advance of the outer cutter, a condition which permits of the use of a head with 14 in. centers equipped with 12 in. cutters to completely cover a surface which by any other method would require that the cutters be interlocked.

The planing of journal boxes in car machine shops is a more or less difficult operation and it seems probable that the Newton ring table type continuous miller would prove valuable in the quantity production of these and similar parts.

Preheating Furnace for Welding Work

THE success of welding depends not only on the skill of the welder but also on the manner in which the job is prepared for welding. Experience has taught that metal cannot be welded cold, because as the weld cools it contracts and pulls away from the cold metal in the casting, thus rendering the job useless. Proper preheating is one of the principal factors in reducing welding costs, and it is



Hauck Preheating Furnace

claimed that the consumption of welding gases can be reduced from 50 to 75 per cent where a good preheating medium is used.

A practical and satisfactory furnace for preheating, made by the Hauck Manufacturing Company, Brooklyn, N. Y., is shown in the illustration. It consists of a deep box or oven, with a detachable cover, mounted on a preheating table. The box is large enough to accommodate a block of six automobile cylinders and other small parts at the same time. It is equipped with three sliding doors, enabling the operator to watch the work and see that it is not overheated. The inside of the box is lined with asbestos, which retains the heat, and the oven can be used for reheating after welding. The burners can then be turned off and the castings allowed to cool gradually.

By removing the box and cover, the furnace is converted into a preheating table. The combustion chambers, through which the flames of the kerosene preheating burners travel, are lined with a patented type of refractory brick, which breaks the flame up into a number of small, soft, radiating flames. This is an important item in evenly and thoroughly transmitting the heat to the castings or broken machine parts.

The furnace has been found valuable for such work as welding gears, crank-cases, and other parts with comparatively large areas and of intricate formation. The even heating prevents cracking and avoids any possibility of unequal expansion.

Frequently, for unusually heavy, cumbersome parts, the preheating can safely be confined to the break, without heating the entire casting. Loose fire bricks or sheet asbestos are used in this case with one or two of the Hauck preheating burners. The table is then called into service, the part placed thereon and the work started. The burners shown are the so-called hand pump type using vaporized kerosene oil as fuel.

Spiral Tooth Cutter and Grinding Machine

THE advantages of spiral cut teeth have long been recognized by users of plain milling cutters. As contrasted with the blow struck by each successive tooth of a straight tooth cutter, the progressive shearing cut with spiral teeth, assures a smooth even surface and permits the use of greater feeds and faster speeds. With these points well in mind, the Pratt & Whitney Company, Hartford, Conn., has developed a formed milling cutter with spiral teeth and eccentric relief to be sold under the trade name of Curvex cutters.

At present, there are in general use two distinct types of cutters for milling contours. The eccentrically relieved formed milling cutters are produced by a broad lathe tool, having a cutting edge of the same contour as the work to be milled. These cutters have the distinct advantage that they can be resharpened by grinding on the face of the tool without changing the form. The contour ground cutter was developed for smoother work and greater freedom in cutting. It is made by gashing the teeth to approximate the desired contour and then finished by grinding each tooth to correspond to a template or former.

Both of the above cutters have straight teeth and consequently are handicapped for production work as the feeds, speeds and depth of cuts have to be restricted in order to produce a smooth surface. It is claimed that Curvex cutters combine all the advantages of the older types of formed cutters, eccentric relief, free cutting qualities and accuracy. In addition to these, they have the advantage of spiral teeth

with the resultant smoothness of cutting and greater feeds and speeds available.

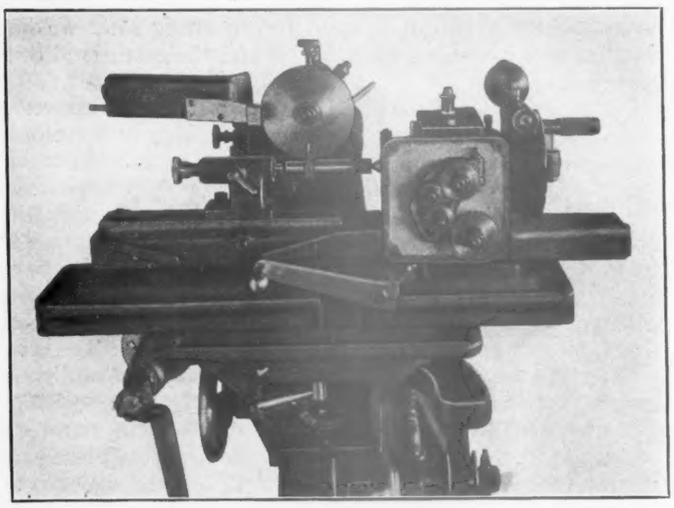
A wide range of sizes is provided and the cutters can be made to order with right or left hand spirals, having prac-

Curvex Spiral Tooth Milling Cutters

tically any lead from 1.607 to 125 in. and with any helix angle up to 20 deg. Due to the fact that no expensive forming tool is necessary these cutters can be manufactured at a slight additional cost over the price of ordinary formed milling cutters.

Curvex Cutter Grinder

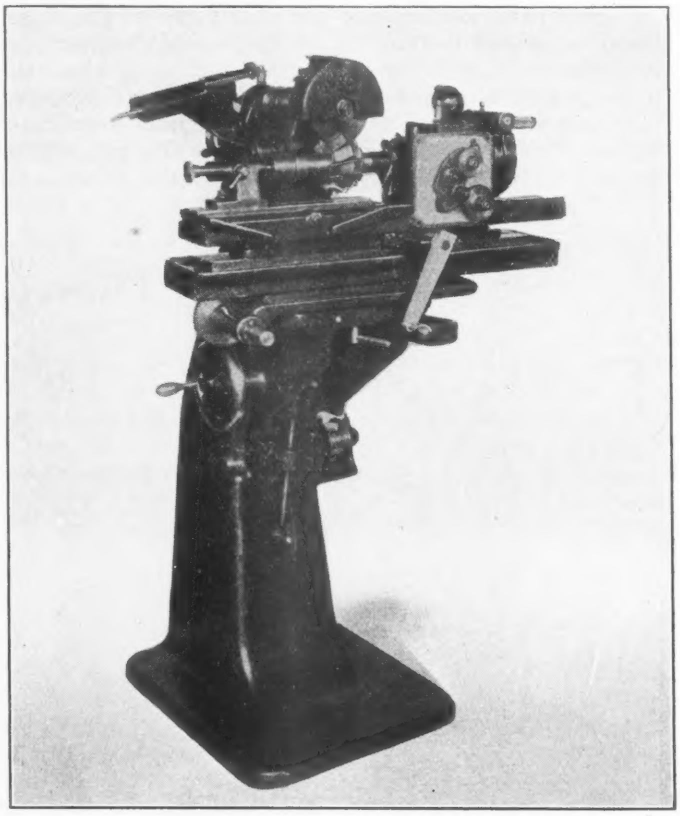
While designed especially for grinding Curvex cutters, this machine can also be used on all types of milling cutters



Front View of Cutter Grinder

and hobs with straight cut teeth. It is also adapted for grinding fluted reamers and similar tools. The machine is equipped with a conical grinding wheel which presents but a single line of contact between the wheel and the work at any one time. The wheel may therefore be made to follow accurately the helical path of the tooth and grind the cutting edge to the required form. There is always considerable difficulty in sharpening spiral hobs with a flat face wheel which is inferior to the cone shaped wheel both as regards accuracy and free cutting.

In grinding the teeth to the required helical path, the machine imparts a combined traverse and rotary movement to the cutter. The table on which the cutter is mounted can be swivelled horizontally about an axis which intersects the axis of the spindle and grinding wheel. When grinding Curvex cutters, the table is swivelled at an angle to corre-



Pratt & Whitney Special Cutter Grinder

spond to the helix angle of the cutter teeth. It is then reciprocated in the usual way by means of a handle operating a rack and pinion. At the same time a reciprocal rotary movement is imparted to the cutter through a set of change gears selected to conform to the lead of the cutter.

An indexing device is provided for successively bringing the teeth in line for grinding instead of holding the back of the tooth against a spring stop. Another interesting feature is the arrangement by which cutters of different sizes can be ground radially without resetting the head or table. The surface of the grinding wheel is kept dressed to the correct shape by means of an accurately mounted diamond. Provision is further made for adjusting this diamond from time to time so as to maintain the true cone angle of the grinding wheel. The machine is arranged for wet grinding which is a feature tending to promote increased production.

Meno Rust Remover and Cleanser

A PREPARATION known as Meno rust remover and cleanser has been developed to remove rust from machines, engines, tools, and all metal surfaces, thereby greatly reducing the time and labor previously required for this work. The compound is a blending of certain chemical ingredients, which in combination produce an electro-chemical action that rapidly loosens and dissolves rust, corrosion, grease, oil, dirt, carbon, paint or any other foreign substance adhering to the metal, irrespective of its age or hardness. It is stated that the action automatically ceases when contact between the cleanser and the metal is established, and it will not injure or mar the surface of the metal itself. One important use of the preparation in railway shops would be in cleaning motion work before repairing it.

The preparation may be applied with a brush or by dipping. It will not burn or explode and protects the metal and

makes it exempt from corrosive or disintegrating action for a long period after treatment. The preparation is an economical one to use, as it does not deteriorate or lose its cleansing power and the same solution may be used many times over. Peter A. Frasse & Company, Inc., New York, are the sole distributors, and are now establishing agencies in various parts of the country for the sale of this preparation.

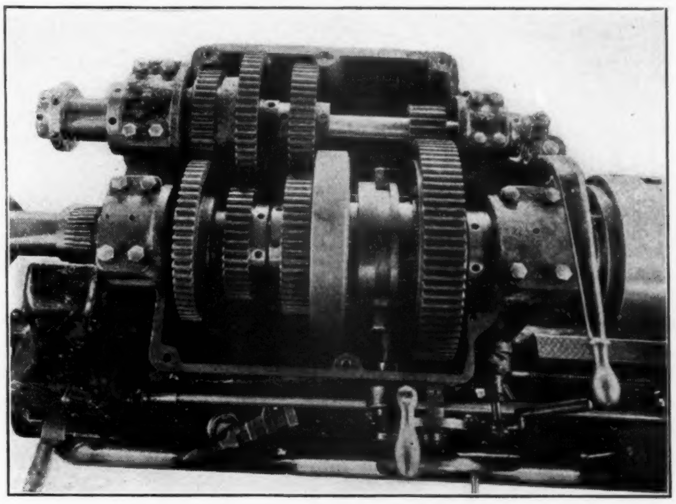
Turret Lathe for Intensive Production

BY the elimination of speeds and feeds not actually necessary for the best high speed production practice, it has been possible to simplify greatly the geared head of the turrent lathe illustrated, which is made by the Millholland Machine Company, Indianapolis, Ind. Only four geared spindle speed changes are furnished, it being maintained that greater production can be obtained where too much reliance is not placed on the operator's judgment as to the speeds and feeds to be used.

Eight broad-face gears and two friction assemblies are provided in the geared head illustrated. A two-step driving pulley is mounted on the back-shaft and provides eight speed changes. But few changes have been made in the friction assembly over other types manufactured by this company. Large driving surfaces are provided with simple adjustments for wear. A bath of oil assures ample lubrication and resultant long life to all moving parts.

Arrangements are made for placing a motor on the headstock cover when individual motor drive is desired. Sight feed lubricators are provided for the main spindle and backshaft bearings. Except for changes in the geared heads, this turret lathe is designed along the same lines as previous models. The tool-post carriage spans the bed, and is arranged to be brought close to the head of the machine, permitting the use of short, sturdy tools. The turret slide and saddle unit is provided with a taper base and taper gibs for horizontal and vertical adjustment. It is operated by a rack and pinion movement, being automatically indexed on the backward movement of the slide.

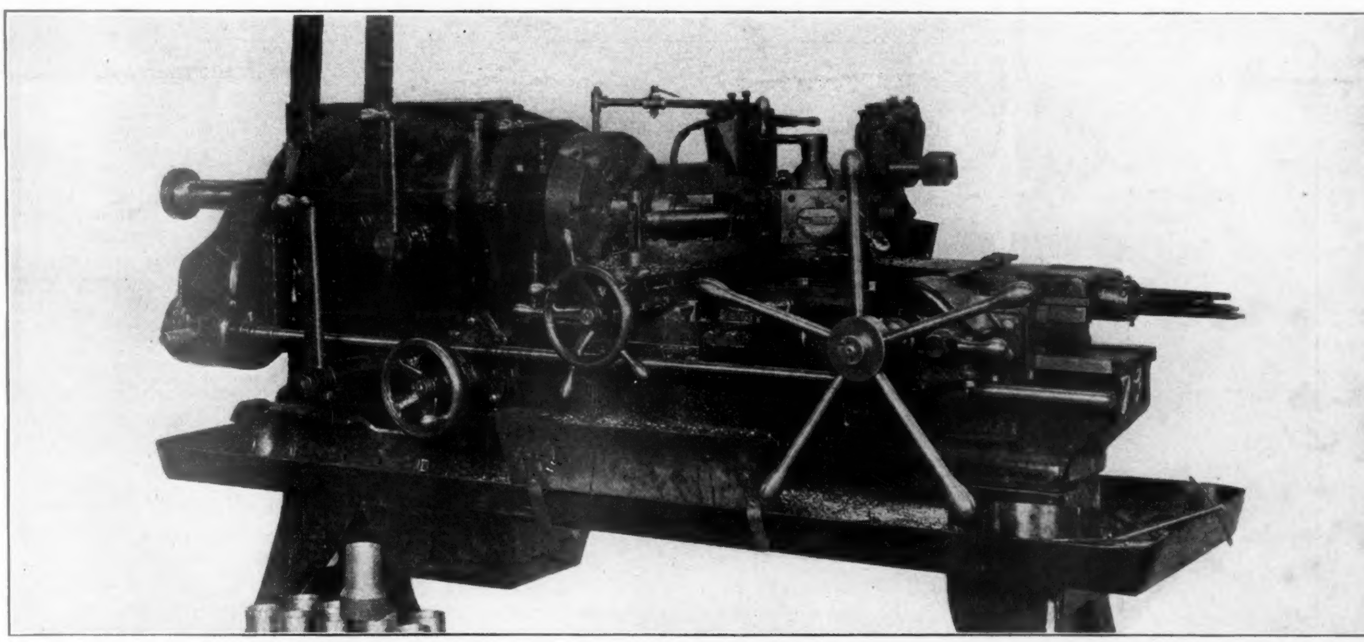
Both the turret and its feed mechanism are interchangeable stops, operating automatically for each position of the turret. Broad bearings are provided for the cut-off slide, which is constructed to insure rigidity under heavy forming and turning cuts. The hand longitudinal feed adjustment is



Gearing Arrangement in Headstock

provided with adjustable clips on a dial so that shoulder positions may be duplicated.

The turret lathe bed is of box section, well ribbed and provided with a pressed steel oil pan and cast iron reservoir



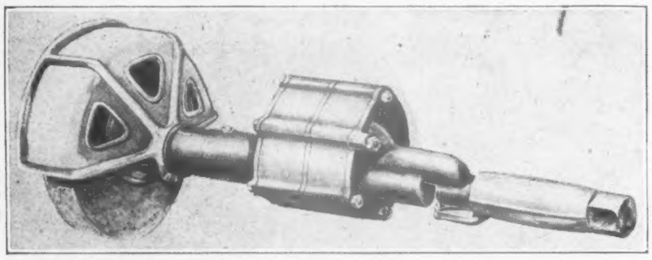
No. 6 Millholland Turret Lathe of 2½-In. Bar Capacity

able with that of the corresponding size cone-head machine. Engagement of the turret feed is by means of the lever of the friction clutch, and eight speed changes are available. The feeds are automatically tripped by independent adjustunderneath. A pump, driven by a pulley on the back gear shaft, furnishes ample cutting lubrication. The new turret lathe is made in three sizes, Nos. 3, 4 and 6, having automatic chuck capacities of 1⅜-in., 1⅝-in. and 2½-in., re-

spectively. The diameters of swing over the turret slide are 6 in., 6¾ in. and 8 in., respectively. The lengths that can be turned are 8 in., 10 in. and 14 in. The respective diameters of swing over bed are 16½ in., 18¾ in. and 21¾ in. Pulleys on the countershafts are recommended to run at speeds of 345, 306 and 283 r.p.m.

Light Weight Portable Pneumatic Grinder

A LIGHT pneumatic grinder, using 6 or 8-in. wheels and weighing 14 lb., has been placed on the market recently by the Roto Pneumatic Company, Cleveland, Ohio. The grinder is simple in both design and construction, there being but three moving parts. The shaft assembly with pistons rigidly mounted constitutes a single rotating member.



Roto Pneumatic Grinding Machine

This, in combination with two self-sealing sliding valves, forms the only moving parts in the motor. By eliminating crank shafts and connecting rods, friction and maintenance costs are greatly reduced. Another advantage is the reduction of motor vibration.

In operation compressed air enters the machine through the control handle and is applied to the pistons in the direction in which the shaft rotates. The turn-handle air control of the motor is self-sealing, absolutely balanced and the throttle will stay in any position in which it is placed by the operator. This control valve will throttle to zero without causing any intermittent pulsation, and when the throttle is closed suddenly, the motor valves automatically release, permitting the air to by-pass and allow the motor to idle down gradually. The air port areas are large and the maximum amount of grinding power can be obtained from the air. Under average conditions about 15 to 20 cu. ft. of free air per min. at 80 lb. pressure are consumed.

The cylinders and valve chest of the motor are of bronze, and bronze bearings are used throughout the machine. The motor bearings are thoroughly lubricated through the center of the shaft from an oil reservoir in the handle of the motor.

Another practical advantage of the machine is the direction of rotation of the grinder, which is such that the sparks and chips are thrown away from the operator and the load of grinding toward him. The machine is adapted for light grinding work around machine shops, such as grinding castings, dressing gas or arc welds, and other miscellaneous grinding work.

Electrical Speed Control for Automatics

MANY advantages in the way of increased flexibility and ease of operation have resulted in the past from the application of electrical speed control to various types of machines. Recognizing this fact, the Cleveland device is particularly valuable in the case of automatic screw machinery because it is often necessary to rotate the work at different speeds for each successive tool set-up and operation. Various different types of mechanism were exper-

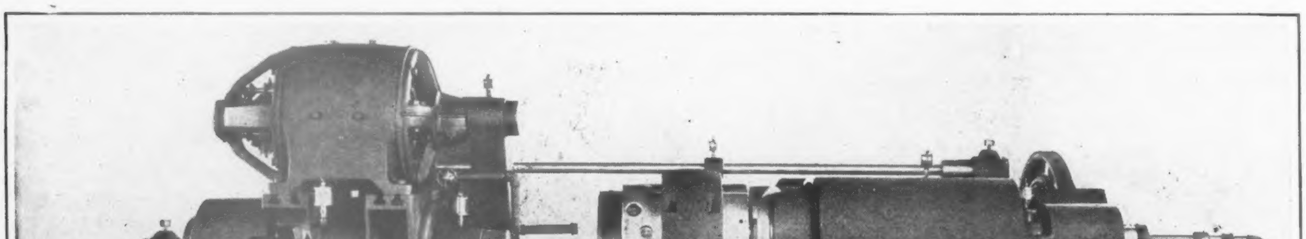


Fig. 1—Large Electrically Controlled Cleveland Automatic Provided With One Driving Motor

Automatic Machine Company, Cleveland, Ohio, after experimenting for a period of two years, has finally developed an automatically controlled spindle speed-changing mechanism to be applied to Cleveland automatic screw machines. This imented with, some of which were automatic and others semi-automatic, or hand operated. The objection to the latter type was that it required one operator for each machine. The machine illustrated is provided with an automatic

mechanism which varies the speed of an adjustable speed-driving motor by regulating the resistance in series with the shunt field windings. It is possible with this mechanism to maintain the correct cutting speed for each tool.

Cleveland automatic screw machines, provided with electrical control, are known as type A automatics. The 1½-in., 2-in., 2½-in., 3-in. and 3½-in. sizes are equipped with two electric motors. One of these is of the adjustable speed reversible type, and is used for driving the spindle only. The other motor runs at constant speed and drives other parts of the machine, including the patented automatic spindle speed controller. The larger, type A automatics, with capacities from 4½ in. to 7¾ in., are provided with only one electric motor. These machines are not furnished with back gears, so that eight changes of spindle speed only are available. Also, because no threading is done on the larger machines, there is no provision for reversing the direction of spindle rotation. As only one motor is used, the power is transmitted to a shaft running along the back of the machine to carry movement to all other members of the machine. Sixteen changes of spindle speed are available on the smaller sized machine, giving a range of 10 to 1 in either direction at any point in the cycle.

Method of Obtaining Automatic Control

Front and rear views of the control mechanism are shown in Figs. 2 and 3. Reference to Fig. 1 shows a push button at *A* which controls the starting and stopping of both motors through a main switch. The drum *B* shown in Figs. 2 and 3, is mounted at the end of the main cam shaft. Other cams

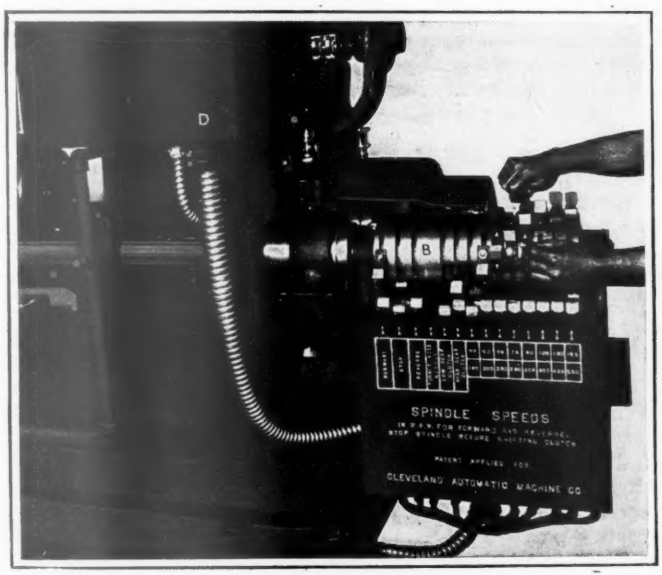


Fig. 2—View Showing Automatic Control Mechanism

on this shaft are so arranged as to properly time all the automatic movements of the machine.

In the smaller sizes of automatics the cam drum *B* is provided with three cams for starting, stopping and reversing the spindle driving motor. Two other cams provide for engaging the high and low speed gears, and the eight cams operate the controller to obtain any of the available speeds. Referring to Fig. 2, the function performed by the several cams, carried on the drum *B*, are plainly marked on the cover plate over the box. In the case of the eight cams that effect speed changes, the speeds that are secured with each cam when the spindle is driven through the high-speed and through the low-speed gears are shown. Each cam engages its respective controller lever at some point in the revolution of the cam shaft. The desired result, in the case of speed changes, is secured when the cams come successively into engagement with respective controller levers when the contactors are carried into engagement with corresponding contacts in the controller box. This results in a variation in field resistance and changes the motor speeds as desired.

The electrical connections are made by a combination rubbing and rolling action that keeps the surface contact clean. Engagement of the high or low speed gears is secured by means of two cams and control levers that operate a solenoid. One complete revolution of the cam shaft and drum *B* means that each cam has performed its function and the finished piece of work has been cut from the bar. A control panel *D* is located at the rear of the spindle-driving

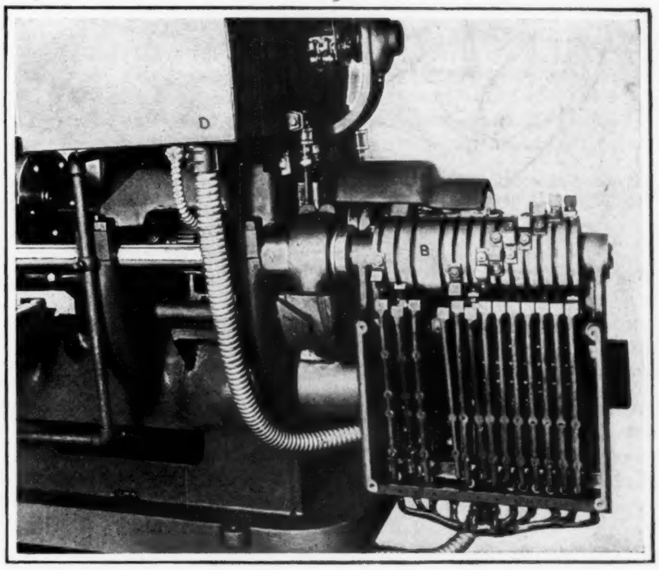
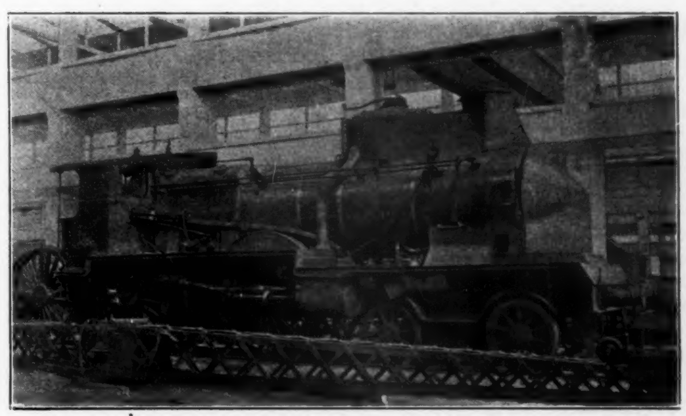


Fig. 3—Automatic Control Mechanism With Cover Plate Removed

motor, and contains the main switch, accelerators and overload coils for both motors. The overload coils are arranged so that an overload on either motor stops the whole machine.

Advantages of Electrical Control

As an example of the flexibility of the Cleveland automatic, due to electrical control, it is maintained that the peripheral speed in a cutting-off operation can be held constant by increasing the speed at which the work is rotated as the tool approaches the center. Maximum production is secured because the cutting speed can be held at the most efficient rate for each operation. Other advantages claimed for this machine are individual motor drive, ease of set-up, and spindle speed changes effected from a standing position as readily as changes in feed.



French Passenger Locomotive in Nevers Shop

Railway Mechanical Engineer

(*Formerly the* RAILWAY AGE GAZETTE, MECHANICAL EDITION *with which the* AMERICAN ENGINEER *was incorporated*)

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WE GUARANTEE, that of this issue 10,300 copies were printed; that of these 10,300 copies, 9,295 were mailed to regular paid subscribers, 5 were provided for counter and news company sales, 263 were mailed to advertisers, 32 were mailed to employees and correspondents, and 705 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 137,350, an average of 11,446 copies a month.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Americanization of foreign-born employees, which has been carried on by the Pennsylvania Railroad systematically for several years, has now been extended to the wives of such employees, plans looking to action in this direction having been adopted at a meeting of the Pennsylvania Railroad Women's Club, in Philadelphia. The Pennsylvania Railroad Mutual Aid Society will co-operate in carrying out these plans.

The recent wrecking of an express train outside of Paris, which resulted in the death of nearly 50 persons, and injuries to many more, is causing the French government to consider the need for the adoption of continuous brakes on freight cars. The accident was caused by several cars becoming uncoupled and crashing into the forward section of the train when it was brought to a stop. The damaged cars blocked the track of the express which arrived immediately after.

The Empire State Express, of the New York Central, has now been running 29 years; Tuesday, October 26, having been the anniversary of the first trip. A sketch of the history of the train is given in the New York Central Magazine for October. For many years the train ran through, westbound, New York to Buffalo, 439 miles, in eight hours, with four stops. As patronage increased, necessitating the lengthening of the train to the capacity of the locomotives, the speed was lowered, and the schedule time is now nine hours. In connection with this notice the Magazine denies the rumor, recently printed in various papers, that engine No. 999, which hauled this train on the Mohawk division for a number of years, had been sent to the scrap heap. This engine, William Buchanan's masterpiece, is now numbered 1086, and is still in service, hauling a local passenger train on the Pennsylvania division. It was built in 1893 and cost $13,000. In the last 13 years it has made 13 visits to the shop for general repairs, which repairs cost $14,253.

London's "Safety First" Council

LONDON.

England is making great efforts to stimulate interest in the "Safety First" movement, and has devised an essay competition for children of railway employees. The contest is open to boys and girls under 16 years of age either of whose parents is employed by a railway company and who resides within 20 miles of Charing Cross, London. The papers are to deal with the avoidance of accidents on railways. The prizes offered are: First £3 (approximately $12), second £2 (approximately $8), third £1 (approximately $4), 14 prizes of ten shillings each (approximately $2), and 28 prizes of 5 shillings each (approximately $1).

St. Louis Railway Exposition

A unique and most successful exhibition of railway appliances was held at St. Louis, Mo., October 25-30. It was developed by a group of railroad officers, representatives of employees, railway supply men and influential citizens of St. Louis, to promote educational work along technical lines among railroad employees, and also to develop a spirit of fellowship and comradeship through the several programs.

Southern in Mississippi Changes Name

Official announcement was made last week that the name of the Southern Railway Company in Mississippi has been changed to the Columbus & Greenville Railroad Company. Hereafter the operations of the company will be carried on under the new name, but under the supervision of the same officers as heretofore.

Car Production—Nine Months' Figures

The production of freight and passenger cars for domestic service in September showed an increase over August. The passenger car deliveries were within one car of being as large as those for any two preceding months. The freight car deliveries were the largest for any month since February, although they were still on the low scale that has characterized this year's production to date. The figures, as reported to the Railway Car Manufacturers' Association by the 21 members of that organization and the two non-members cooperating with it in this matter, show deliveries in September of 3,529 freight and 38 passenger cars for domestic service; 1,088 freight cars for export, and freight car repairs amounting to 3,140.

American Railway Association Holds Annual Meeting

The Annual Session of the American Railway Association was held at the Blackstone, Chicago, on Wednesday, November 17, 1920, with R. H. Aishton, president of the association, in the chair. Announcement was made that the following were elected members of the board of directors by letter ballot: E. W. Beatty, president, Canadian Pacific; B. F. Bush, president, Missouri Pacific; W. R. Scott, president, Southern Pacific, Texas-Louisiana Lines; A. H. Smith, president, New York Central Lines; W. G. Besler, president and general manager, Central of New Jersey; W. H. Truesdale, president, D. L. & W.; E. J. Pearson, president, N. Y., N. H. & H.; J. H. Hustis, president, Boston & Maine; W. W. Atterbury, vice-president, Pennsylvania System; Daniel Willard,

president, Baltimore & Ohio; Hale Holden, president, Chicago, Burlington & Quincy; W. B. Storey, president, Atchison, Topeka & Santa Fe; H. E. Byram, president, Chicago, Milwaukee & St. Paul; C. H. Markham, president, Illinois Central; C. R. Gray, president, Union Pacific System; N. D. Maher, president, Norfolk & Western; W. L. Mapother, executive vice-president, Louisville & Nashville; H. G. Kelley, president, Grand Trunk.

The Power of Collective Bargaining

The national campaign committee of the sixteen railroad labor organizations addressed a letter to the members of the organizations, outlining instructions as to how to assist in the defeat for re-election of those members of Congress who voted for the transportation act, which contains the following characterization of the law:

"Adroitly phrased by railroad attorneys to achieve that purpose, the Cummins-Esch law destroys collective bargaining by railroad employees through their various crafts, and renders almost valueless protective agencies built up through years of struggle by employers' organizations. This is accomplished in part by the labor sections of the bill and in part by its guaranty provisions.

"The real power behind collective bargaining is the ability and right, when justice warrants, to cause the employer financial loss. Collective bargaining does not function against a guaranteed employer. No employer need fear financial loss occasioned by strikes or vacations of employees if the government or the people are required by law to make up the loss."

The "Best Friend of Charleston"

October marked the ninetieth anniversary of the landing of this historic locomotive in Charleston, S. C., the ship Niagara, bearing the engine from New York, having reached Charleston on October 23, 1830. The Southern Railway Company, in which system the pioneer railroad is now included, commemorates the event by a brief notice in its News Bulletin for September.

The "Best Friend" weighed about four or five tons; or, say, from one-fortieth to one-thirtieth the weight of a Southern Railway express locomotive of today.

The engine was built at the West Point foundry, New York, and the design is credited to Horatio Allen, who ran the Stourbridge Lion, the first locomotive that was ever moved on a track in America. Allen was chief engineer of the South Carolina Canal & Railroad Company. This railroad, extending from Charleston westward to Hamburg, S. C., opposite Augusta, Ga., was the first continuous 10 miles of railway in the world; the second railroad in the United States; the first to run a steam locomotive built in the United States for regular service, and the first in America built with the intention of using steam as motive power.

Metropolitan Section of American Welding Society

The newly formed Metropolitan section of the American Welding Society, at its first meeting on the afternoon of October 25 in the Engineering Societies building, elected the following officers: Chairman, H. A. Currie, assistant electrical engineer, New York Central Railroad; first vice-chairman, E. E. La Schaum, general superintendent motor equipment, American Railway Express Company; second vice-chairman, E. M. T. Rider, chief engineer, Third Avenue Railway Company; treasurer, W. E. Gray, Jr., New York sales manager, Elyria Enameled Products Company; secretary, Howard Odiorne, Submarine Boat Corporation.

Executive Committee

To serve for three years: H. G. Thompson, Transportation Engineering Corporation; William R. Hulbert, Metal & Thermit Corporation; E. J. Kingsbury, United Marine Contracting Corporation; J. C. O'Connell, Federal Shipbuilding Company.

To serve for two years: F. W. Smith, chief engineer, Oxweld Acetylene Company; A. E. Gaynor, J. A. Roebling's Sons Company; Charles H. Haupt, Standard Oil Company; Charles P. Burr, G. M. Meurer Steel Barrel Company.

To serve for one year: R. W. Baker, Lincoln Electric Company; D. Ahldin, Commercial Acetylene Supply Company; M. W. Kellogg, M. W. Kellogg Company; Allen L. Price, Beckley Perforated Company.

Liquidation Staff of the U. S. R. A.

As indicating the extent of the work required to settle up the affairs of the Railroad Administration, which for 26 months had charge of the operation of the railroads, its staff of officers and employees on August 20 included 1,195 persons and its monthly payroll was $250,576. Only a small reduction in force has been made during the period since the railroads were relinquished, although the staff is now only about half as large as it was immediately prior to the return of the roads. On March 1, according to a statement issued by Director General Hines, the force was reduced to 1,223 officers and employees, 1,420 having left the service of the central and regional administrations by March 1. In June, 1919, the total force was 2,725 and the monthly payroll was $575,428. On February 20, 1920, it was 2,612 and the monthly payroll was $570,078.

Shop Construction

CORNWALL.—This company has awarded a contract to the Austin Company, Cleveland, Ohio, for the construction of a machine and locomotive erecting shop at Lebanon, Pa. The new building will be of reinforced concrete, brick and steel construction. The dimensions will be 140 ft. by 180 ft. and 50 ft. high. The cost is estimated at approximately $160,000.

GULF COAST LINES.—This company is constructing temporary buildings at Kingsville, Tex., to replace the machine shops which were destroyed by fire, pending the completion of plans for permanent shop facilities.

MISSOURI PACIFIC.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a power plant at Dupo, Ill., to cost approximately $15,000.

ST. LOUIS-SAN FRANCISCO.—This company has awarded a contract to the William McDonald Construction Company, St. Louis, Mo., for the construction of a roundhouse and machine shop at Dublin, Tex. The Frisco has also awarded contracts to the Hedges-Weeks Construction Company, Springfield, Mo., for the setting of a new turntable, and the construction of cinder conveyors and materials racks at Dublin. An addition to the car repair shop of this company at Fort Scott, Kan., is being built by the T. S. Leake Construction Company, Chicago, at a cost of about $15,000.

SOUTHERN.—This company is building a brass foundry at its Lenoir Car Works, Lenoir City, Tenn., which will cost approximately $30,000. The building will be one story, 62 ft. by 120 ft., of brick and concrete construction. This addition to the plant will involve the purchase of five revolving furnaces, a metal separator and a journal bearing boring machine.

SOUTHERN PACIFIC.—This company will construct the following buildings at Sacramento, Cal.: A reinforced concrete oil and paint house, 65 ft. by 100 ft.; a store building of mill construction with corrugated iron sides, and concrete foundation, 500 ft. long and 60 ft. wide, and a planing mill of mill construction, with corrugated iron sides and roof, to be 126 ft. wide and 360 ft. long.

Reduction of Forces

Reductions of railroad forces by the dismissal of considerable numbers of men on short notice, particularly in shops, has been reported recently from many places. The Pennsylvania Railroad, in dismissing 1,350 men at the Altoona shops, about 15 per cent of the total force, giving the men five days' notice, announced that this was to be deemed a permanent reduction in force, not a temporary lay-off. This move was made necessary by a reduction in the volume of repair work and affected all departments except the iron and brass foundries. About 1,500 employees were dismissed from shops on the Central Pennsylvania division of the road and 1,000 on the Philadelphia division. The New York Central dismissed 500 men at West Albany, four-fifths of these being shop men. The Boston & Albany has dismissed about ten

per cent of the forces in its principal shops. The New York, New Haven & Hartford has dismissed considerable numbers of men in various departments. Certain shops of the Baltimore & Ohio report dismissals of ten per cent of the employees.

Recent Locomotive Orders

National Railways of Mexico.—Florian & Co., Ltd., importers and exporters, 52 Wall street, New York, confirm the report that they have closed a contract with the Mexican government for the delivery of $20,000,000 of railroad equipment and material. The negotiations were completed in Mexico City and the contract is signed by the Minister of Railways and the National Railways of Mexico. The contract calls for the delivery of locomotives, cars and material for section houses. Certain credits have been extended to Mexico in this connection which are properly secured; all financial arrangements in connection with this contract have been completed. Florian & Co., Ltd., further confirm the report that the purchase of the equipment will be made through their New York office.

Freight Car Orders

The National Railways of Mexico has ordered 100 tank cars of 12,000 gallons capacity from the American Car & Foundry Company.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

Air-Brake Association.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

American Railway Association, Division V—Mechanical.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

Division V.—Equipment Painting Division.—V. R. Hawthorne, Chicago.

American Railway Association, Division VI.—Purchases and Stores.—J. P. Murphy, N. Y. C., Collinwood, Ohio.

American Railroad Master Tinners', Coppersmiths' and Pipefitters' Association.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

American Railway Tool Foremen's Association.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

American Society for Testing Materials.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

American Society for Steel Treating.—W. H. Eisenman, 154 E. Erie St., Chicago.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411 C. & N. W. Station, Chicago.

Canadian Railway Club.—W. A. Booth, 131 Charron St., Montreal, Que. Next meeting December 14. Paper on The Every Day Duties of a Roadmaster will be presented by E. Keough, assistant engineer of maintenance of way, Canadian Pacific Railway, Montreal. Illustrated by stereopticon views.

Car Foremen's Association of Chicago.—Aaron Kline, 626 N. Pine Ave., Chicago. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago.

Car Foremen's Association of St. Louis.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

Central Railway Club.—H. D. Vought, 95 Liberty St., New York. Meetings second Thursday in January, March, May, September and November, Iroquois Hotel, Buffalo, N. Y.

Chief Interchange Car Inspectors' and Car Foremen's Association.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

Cincinnati Railway Club.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings second Tuesday in February, May, September and November, Hotel Sinton, Cincinnati, Ohio.

Dixie Air Brake Club.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

International Railroad Master Blacksmiths' Association.—W. J. Mayer, Michigan Central, 715 Clarke Ave., Detroit, Mich.

International Railway Fuel Association.—J. G. Crawford, 702 East 51st St., Chicago.

International Railway General Foremen's Association.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

Master Boilermakers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention May 23 to 26, 1921, inclusive, Planters' Hotel, St. Louis, Mo.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting December 14. Paper on Some Phases of Railway Operations in Canada will be presented by Grant Hall, vice-president, Canadian Pacific Railway Company.

New York Railroad Club.—H. D. Vought, 95 Liberty St., New York. Second annual dinner, Hotel Commodore, New York, Thursday, December 16, at 6:30 p. m.

Niagara Frontier Car Men's Association.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y. Regular meetings January, March, May, September and October.

Pacific Railway Club.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings second Thursday in month, alternately in San Francisco and Oakland, Cal.

Railway Club of Pittsburgh.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in month except June, July and August, American Club House, Pittsburgh.

St. Louis Railway Club.—B. W. Frauenthal, Union Station, St. Louis, Mo.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. R. R., Meetings second Friday in month except June, July and August. Buffalo, N. Y.

Western Railway Club.—Bruce V. Crandall, Chicago. Meetings third Monday in month except June, July and August.

PERSONAL MENTION

GENERAL

C. E. Bingham has been appointed supervisor of mechanical examinations of the Michigan Central, with headquarters at Detroit, Mich.

J. Herron has been appointed acting superintendent of motive power of the Duluth, South Shore & Atlantic, with headquarters at Marquette, Mich., succeeding J. J. Conolly, granted leave of absence.

Charles A. Nelson, formerly senior mechanical engineer, Bureau of Valuation, Interstate Commerce Commission, has returned to the mechanical engineer's office of the Delaware & Hudson at Watervliet, N. Y.

D. M. Pearsall, superintendent of motive power of the Atlantic Coast Line, second and third divisions, with headquarters at Waycross, Ga., has been transferred as superintendent of motive power, first division, with headquarters at Rocky Mount, N. C. J. E. Brogdon, shop superintendent at Waycross, Ga., has been appointed superintendent of motive power, second and third divisions, with the same headquarters, succeeding Mr. Pearsall. F. P. Howell, master mechanic at Savannah, Ga., has succeeded Mr. Brogdon as shop superintendent at Waycross, and J. W. Reams has been appointed master mechanic at Savannah, succeeding Mr. Howell.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

Edward France has been appointed road foreman of locomotives of the Mohawk division of the New York Central with headquarters in Rensselaer, N. Y.

S. J. Kelley has been appointed master mechanic of the Erie, with headquarters at Hornell, N. Y. This appointment is the result of the division of the territory of C. H. Norton, who remains master mechanic of the Susquehanna and Tioga divisions, but relinquishes the Allegheny and Bradford divisions to Mr. Kelley.

C. J. Quantic, master mechanic of the Canadian National at Port Mann, B. C., has been transferred to Vancouver and given jurisdiction over all lines west of and not including Edmonton, Alta. A. H. Mahan, district master mechanic of the Grand Trunk Pacific at Edson, Alta, has been appointed assistant master mechanic of the Canadian National and the Grand Trunk Pacific, with the same headquarters. Mr. Mahan will have jurisdiction over the lines from Edmonton, Alta., to McBride, B. C., and from Edson, Alta., to Mountain Park, Alta. A. Walts, district master mechanic of the Grand Trunk Pacific, with headquarters at Smithers, B. C., has been appointed assistant master mechanic of the Canadian National and the Grand Trunk Pacific, with the same headquarters. His jurisdiction will include all lines from McBride, B. C., to Prince Rupert.

CAR DEPARTMENT

A. H. Eager has been appointed general superintendent of rolling stock on the Canadian National and Grand Trunk Pacific, with headquarters at Winnipeg, Man. Mr. Eager was born on July 15, 1868, at Waterloo, Que., and entered railroad service in June, 1885, as a machinist apprentice in the shops of the Southeastern, at Farnham, Que. After a short time he left the service of this road to enter the shops of the Canadian Pacific, at Farnham, and was made a machinist in 1893. After serving as machinist for six years, he was made locomotive shop foreman and served in this capacity until 1901, when he was promoted to locomotive foreman, at Megantic, Que. In 1903, he was transferred to Cranbrook, B. C., where he was employed until May, 1906, when he was promoted to general foreman, with headquarters at Calgary, Alta. From 1907 to 1910, Mr. Eager served successively as district master mechanic, with headquarters at Kenora, Ont., and as locomotive foreman at Calgary, Alta. In 1910, he entered the service of the Canadian National, as superintendent of shops, with headquarters at Winnipeg, Man., a position which he held until August, 1916, when he was promoted to assistant superintendent

of rolling stock of the Western lines of the Canadian National. At the time of his recent appointment, Mr. Eager was mechanical superintendent of the Canadian National, with headquarters at Winnipeg, a position to which he had been promoted in December, 1918. The office of mechanical superintendent has been abolished.

SHOP AND ENGINEHOUSE

C. W. ADAMS, general foreman of locomotives on the Michigan Central, with headquarters at St. Thomas, Ont., has been promoted to superintendent of shops, with jurisdiction over the locomotive department, and with headquarters at Jackson, Mich., succeeding W. C. Bell, who has been transferred to Bay City, Mich.

P. J. FLYNN, general roundhouse foreman of the Erie at Hornell, N. Y., has accepted a position in the Lehigh Valley shops at Pittston, Pa., as general foreman.

I. W. HICOK, erecting shop foreman on the Chicago & Alton, with headquarters at Bloomington, Ill., has been promoted to superintendent of shops, with the same headquarters, succeeding J. J. Carey. William Monroe succeeds Mr. Hicok.

PURCHASING AND STOREKEEPING

B. B. BRAIN, fuel agent of the Kansas City Southern, with headquarters at Kansas City, Mo., has been appointed purchasing agent, succeeding G. W. Bichlmeir, resigned to accept service with another company.

F. S. HAMMOND, general storekeeper of the Pittsburgh, Shawmut & Northern, has been appointed purchasing agent in addition to his other duties.

G. H. WALDER, assistant purchasing agent of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has been promoted to purchasing agent, succeeding W. A. Linn, who has been assigned to other duties.

OBITUARY

C. C. HIGGINS, superintendent of motive power of the St. Louis-San Francisco, was killed at Racine, Mo., the night of November 3, when a freight train crushed into his private car. Mr. Higgins was born at Aurora, Ill. He graduated from the mechanical engineering department of the University of Minnesota in 1900, and immediately entered railroad work as a special apprentice in the service of the Chicago, Burlington & Quincy. After five years with that road, during which he served successively as assistant in the laboratory, roundhouse foreman and general roundhouse foreman at various points on the line, he left to become associated with the American Brake Shoe & Foundry Co., in its Chicago office. During the next four years he served as sales engineer and salesman with this company. In 1909, however, he returned to railroad service, accepting an appointment with the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kan., where he was assigned to special work in connection with the motor schedules of the mechanical department. In 1912 he was engaged by J. W. Kendrick, consulting railway engineer, Chicago, to make reports on various railroads in connection with the valuation and rehabilitation of their properties. When the position of assistant to the vice-president of the St. Louis-San Francisco was created on March 15, 1918, Mr. Higgins was appointed to that position. He was made superintendent of motive power on March 1, 1920, the position he held at the time of his death.

C. C. Higgins

SUPPLY TRADE NOTES

F. M. Whyte, vice-president, with office at New York, of the Hutchins Car Roofing Company, Detroit, Mich., has resigned.

The Colburn Machine Tool Company has removed its entire business from Franklin, Pa., to its new plant at 1038 Ivanhoe road, Cleveland, Ohio.

W. A. Ruth, who recently resigned from the sales force of the National Car Coupler Company, has become affiliated with the Superior Steel Castings Company, Benton Harbor, Mich.

G. Schrimer has resigned as sales engineer in the Detroit office of the Whiting Foundry Equipment Company, Whiting, Ill., and is now associated with W. C. Bennett, industrial engineer, Chicago.

Albert E. Newton, vice-president and general manager of the Reed-Prentice Company, has resigned. He will, however, remain with the Reed-Prentice Company in an advisory and consulting capacity until 1922.

D. J. Crowley has been appointed Michigan sales agent of the Tacony Steel Company, Philadelphia, Pa. Mr. Crowley's office is in the Dime Bank building, Detroit, Mich. D. B. Carson has been appointed Cleveland district sales manager.

G. E. Anderson, assistant eastern sales manager of the Duff Manufacturing Company, Pittsburgh, has been promoted to southwestern sales manager and placed in charge of the new branch office located in the Railway Exchange Building, St. Louis, Mo.

Joseph Markham, formerly railway sales representative of the E. I. Du Pont de Nemours & Co., Inc., has been appointed sales agent of the Pressed Steel Car Company and the Western Steel Car & Foundry Company, with an office in the Peoples Gas building, Chicago.

W. H. DeWolfe recently has been appointed district manager of the New Britain Machine Co., with headquarters at Room 638, Old South building, 294 Washington street, Boston. Mr. DeWolfe formerly was connected with the Philadelphia office of this company.

The Blaw-Knox Company, Pittsburgh, Pa., has established a new sales district in the South, with headquarters at Birmingham, Ala. Prescott V. Kelly, formerly connected with the executive sales department at Pittsburgh, is in charge of this office, which is located in the American Trust building.

C. F. Meyer, assistant secretary of the Landis Machine Company, Waynesboro, Pa., will leave shortly for an extended trip to the Orient in the interests of his company. Mr. Meyer will visit England, India, the Dutch East Indies, Australia, the Philippine Islands, China, Japan and the Hawaiian Islands.

Anton Becker, assistant to president of the Ralston Steel Car Company, Columbus, Ohio, has been elected vice-president to succeed F. E. Symons, who has been elected president. The other officers of the company are F. A. Livingston, secretary and treasurer, and L. C. Roy, assistant secretary and assistant treasurer.

Frederick T. Davis, formerly with the Davidson Tool & Manufacturing Corporation, is now connected with the New York branch office of the Reed-Prentice Company, the Becker Milling Machine Company and the Whitcomb-Blaisdell Machine Tool Company, located at Grand Central Palace, New York city.

The Chicago Pneumatic Tool Company announces the removal of its rock drill plant from 864 East Seventy-second street, Cleveland, Ohio, to its Boyer pneumatic hammer plant at 1301 Second boulevard, Detroit, Mich. The company's Little Giant air drill plant still remains at 1241 East Forty-ninth street, Cleveland.

R. G. Barrington, formerly connected with the Cleveland Twist Drill Company, Cleveland, Ohio, has been appointed Cleveland sales manager for the Reed-Prentice Company, the Becker Milling Company and the Whitcomb-Blaisdell Machine Tool Company, with headquarters at 408 Frankfort avenue, Cleveland, Ohio.

L. R. Fedler has been appointed district manager for the Keller Pneumatic Tool Company in the Milwaukee district, with offices at 915 Majestic building, Milwaukee. For the past twelve years, Mr. Fedler has been associated with the sales organization of the Chicago Pneumatic Tool Company in the Milwaukee territory.

The Howard N. Potts medal, which is awarded for distinguished work in science and mechanical arts by the Franklin Institute, was presented on October 20 to E. P. Bullard, Jr., president of the Bullard Machine Tool Co., Bridgeport, Conn., for his work in connection with the development of automatic machinery in the metal-cutting field.

A new policy of direct selling for all three companies has been established, under the charge and control of John P. Ilsley, formerly general manager of the Becker Milling Machine Company's plant. Branch sales offices have been established in the leading cities of the United States and a foreign sales manager has been employed for Europe.

Alfred J. Babcock, president of Manning, Maxwell & Moore, Inc., New York, who retired in May, 1920, on account of ill-health, died on October 30, in London, England, after a short illness. He was born at Brookfield, N. Y., in 1850, and served in the United States Army from 1867 to 1871. He took a law course at Ann Arbor, and practiced law in Denver, Colo., from 1882 to 1884. Mr. Babcock entered the machinery business in Chicago with the Fay & Egan Company and later entered the employ of Manning, Maxwell & Moore, Inc., at Chicago, as manager of that branch. About seven years ago he came to New York as assistant to president, and later was made president. He retired from active service in May, 1920, on account of continued ill health.


A. J. Babcock

The name of the selling organization which C. C. Bradford recently formed, has been changed from the Manufacturers' Sales Company, to the Bradford Sales Company. The offices of this company, which will represent not more than two manufacturers as a district sales office of each, are located at 340 Leader-News building, Cleveland, Ohio.

C. E. Hildreth has offered to resign as president of the Whitcomb-Blaisdell Machine Tool Company, in view of the consolidation in management. He has been requested, however, to allow the situation to remain in statu quo, which he has consented to do, pending the working out of the plan for centralizing the management of the different plants.

Steps have been taken to centralize the production and manufacturing departments, and F. O. Hoagland, until recently vice-president and general manager of the Bilton Machine Tool Company, Bridgeport, Conn., has taken the position of general manager of the Reed-Prentice Company, the Becker Milling Machine Company and the Whitcomb-Blaisdell Machine Tool Company.

A. H. Tuechter, president of the Cincinnati-Bickford Tool Company, Oakley, Cincinnati, Ohio, was elected president of the National Machine Tool Builders' Association, at its annual meeting at the Hotel Astor, New York. Mr. Tuechter has served that organization as second vice-president, and at one time was a member of the joint general committee of the American Society of Mechanical Engineers.

Under the name of Midgley & Borrowdale, a partnership, with headquarters in the McCormick building, Chicago, has been formed by S. W. Midgley and J. M. Borrowdale, both of whom were formerly connected with the Liberty Steel Products Company, to deal in railway supplies. A contract has already been closed with the Superior Steel Castings Company, Benton Harbor, Mich., manufacturers of steel and malleable iron castings, for the exclusive railway sales of the company's products, and the partners are also western sales representatives of the Pneumatic Safety Valve Company, Woonsocket, R. I., manufacturers of safety air valves for pneumatic tools; the Henry Giessel Company, Chicago, manufacturers of sanitary filters and water coolers for passenger cars and locomotives, and the Trumbull Waste Company, Philadelphia, Pa.


S. W. Midgley

S. W. Midgley entered railroad service in 1898, in the office of the Car Mileage Bureau. In 1902, he entered the railway supply business as general sales representative of the National Car Coupler Company, remaining with this company until late in 1907. He then became connected with the Curtain Supply Company as western sales representative, later becoming western sales manager. In 1911 he left the Curtain Supply Company to enter the service of the Acme Supply Company as general sales manager, remaining in the service of this company until January 1, 1918. He then became district manager of the Chicago office of the Liberty Steel Products Company and remained with that company until the closing of its Chicago office, September 30, 1920.

J. M. Borrowdale began railroad service in 1890, with the Fitchburg Railroad, at Boston, Mass. In 1893 he came to Chicago to enter the employ of the Chicago, New York & Boston Refrigerator Company as a car builder. He remained with this company until 1896, when he left to enter the Burnside shops of the Illinois Central. Here he served successively as a car buider, foreman, and general foreman, until 1909, when he was appointed superintendent of the car department of that road. In 1917, he left railway service to join the sales force of the H. W. Johns-Manville Company, and two years later went with the Liberty Steel Products Company, with which company he remained until the Chicago office was closed, September 30, 1920.


J. M. Borrowdale

E. P. Williams, formerly with McJunkin Advertising Agency, and later director of field work, Bureau of Market Analysis, Inc., has joined the staff of the Independent Pneumatic Tool Company, manufacturers of Thor air and electric tools. Mr. Williams will be located in Chicago.

The Reed-Prentice Company, the Becker Milling Machine Company and the Whitcomb-Blaidsell Machine Tool Company, which are largely owned and controlled by the same interests, have decided, for the purpose of efficiency, to consolidate still further the operating management of all three plants, with the result that a centralized executive office has been established at 53 Franklin street, Boston, Mass., under the direction of Arthur H. Weed, president.

The Graver Corporation, East Chicago, Ind., manufacturers of steel tanks and general plate construction, oil refinery equipment, water softening and purifying equipment, announces the opening of branch offices in the following cities: New York, 280 Broadway; Pittsburgh, Pa., 62 Conestoga building; Kansas City, Mo., 1001 Gloyd building; Cincinnati, Ohio, 220 Gwynne building; Toledo, Ohio, 314 Nicholas building, and San Francisco, Cal., 312 Balboa building.

Donald S. Barrows, chief engineer and works manager of The T. H. Symington Company, New York, since 1917, with headquarters at Rochester, N. Y., has been elected vice-president in charge of operations. He was born at New Haven, Conn., in 1877, and graduated from the New York Law School in 1898 and was admitted to the bar in New York State in 1899. Following his entry into the engineering field and previous to his association with the Symington organization Mr. Barrows held the following positions: Chief engineer of the North Penn Iron Company, Philadelphia, Pa.; chief engineer of the Insley Iron Works, Indianapolis., Ind.; mechanical engineer of the Wonham-Magor Car & Manufacturing Company, and mechanical engineer with the American Car & Foundry Company, at New York. Mr. Barrows entered the service of The T. H. Symington Company in 1915, and as chief engineer had charge of all engineering matters in conection with the Symington railway products as well as the planning, enlargement and execution of extensive plant improvements. In 1917 he was promoted from the position of chief engineer to chief engineer and works manager, and now becomes vice-president in charge of operations. In the development of the Symington company's extensive railway business at Rochester to its present state of efficiency in quality and quantity production Mr. Barrows has been largely responsible.

D. S. Barrows

Fairbanks, Morse & Co., Chicago, have bought the entire business consisting of all stock on hand, good-will and liabilities of the Luster Machine Shop & Railway Equipment Company, 917 Arch street, Philadelphia, Pa. Fairbanks-Morse have opened a new branch at this address under the management of D. W. Dunn, and will sell its complete line of engines, motors, pumps, etc. The entire personnel of the Luster Machinery Co. has been retained. E. J. Luster, former president, will be manager of the machine tool division of the Fairbanks-Morse Philadelphia branch.

L. C. Wilson, for the past two years general sales manager of the Chain Belt Company, Milwaukee, Wis., has been elected secretary of the Federal Malleable Company, West Allis, Wis., manufacturers of malleable castings, malleable chain and the Rapid molding machine. Mr. Wilson, after graduating from Yale University, began his business career as a salesman with Harbison-Walker Refractories Company, Pittsburgh. In 1917 he became associated with the Chain Belt Company and served as assistant to the vice-president until his appointment as sales manager. Clifford F. Messinger, who is also a graduate of Yale University, and has been with the Chain Belt Company since 1909 in various capacities, including that of advertising manager, manager of Rex concrete mixer sales and assistant to the vice-president, has been appointed sales manager of the Chain Belt Company, to succeed Mr. Wilson.

The Morse Chain Company, Ithaca, N. Y., has established a branch factory in Detroit which will be devoted exclusively to the manufacture of silent chain sprockets and the Morse adjustment for use in automobile power transmissions. The manufacture of chains and power transmission at the main plant at Ithaca will continue. The Detroit branch will be under the general management of F. C. Thompson, with F. M. Hawley as chief engineer, and C. B. Mitchell as factory manager. The sales and engineering offices are located at the Detroit plant, Eighth and Abbott streets.

Arthur E. Hauck, president of the Hauck Manufacturing Company, makers of oil burning appliances, kerosene torches, furnaces and forges, Brooklyn, N. Y., died at his home in that city on October 30, at the age of 41. He was born in Germany, where he learned the trade of coppersmith. At the age of 20 he came to America and in 1902 began business in Brooklyn. He was the inventor of a number of appliances for burning oil, one of which was the method of vaporizing kerosene in a torch with proportioned heat-resisting nozzle, the form of vaporization which is used to reduce carbonization to a minimum.

The J. B. Engineering Sales Company, 60 Prospect street, Hartford, Conn., has been appointed Connecticut sales agent of the Conveyors Corporation of America, formerly the American Steam Conveyor Corporation. The J. B. Engineering Sales Company is owned by John Breslau, who is a graduate of the Sheffiield Scientific School, Yale University, and was formerly sales engineer, manager of publicity and production manager of the Terry Steam Turbine Company. The J. B. Engineering Sales Company is sales agent also for the Griscom Russell Company and the Terry Steam Turbine Company, in Connecticut.

J. B. Webb has been appointed western representative of the Diamond Specialty & Supply Company, Philadelphia, Pa. Mr. Webb has, for many years, been manager of the railway supply department of the Simmons Hardware Company, and in that capacity handled the products of the Diamond Specialty & Supply Company, including water gage glasses, lubricator glasses, Watertown automatic cylinder cocks, Steinbrunn boring bars and other devices. Through this new arrangement he will sell these goods to the railroads operating out of Chicago and west of the Mississippi river. Mr. Webb's headquarters are at 713 Chestnut street, St. Louis, Mo.

John A. Talty, assistant superintendent of equipment and equipment inspector for the New York Public Service Commission, Second district, has taken a position as special engineer with the Franklin Railway Supply Company, New York. Mr. Talty began railway work in 1883 as freight brakeman on the Erie Railroad. He consecutively served as foreman and locomotive engineman on that road and then as air brake instructor on the Westinghouse air brake instruction car on the Erie. Later he took a similar position with the Scranton Correspondence School. From 1900 to 1910 he served as road foreman of engines on the Delaware, Lackawanna & Western. In the latter year he joined the force of the public service commission as assistant supervisor of equipment and equipment inspector, inspecting locomotives and cars and investigating accidents, and he now leaves that position to go to the Franklin Railway Supply Company.

The Landis Machine Company, Waynesboro, Pa., has just completed a new addition to its shop, which will be the main machine shop. This new building is 308 ft. long by 146 ft. wide. Nearly 365 tons of steel were used in the construction, which was under the direction of A. R. Warner. The building is modern in every respect, being provided with the best of heating and lighting arrangements. A five-ton crane with a span of 66 ft. operates the entire length of the building and will provide means for moving heavy castings. On October 30 the company gave a house warming party in the new shop to Landis employees and their families. Approximately 1,400 guests attended and enjoyed the

good things arranged for them. Addresses were made by J. C. Benedict, general manager, and S. F. Newman, assistant general manager of the Landis Machine Company. The party was concluded in the evening by a special entertainment, after which the employees presented to the management a set of resolutions expressing thanks and appreciation for the good time afforded and opportunity for closer fellowship.

F. Hopper has resigned as division master mechanic of the Chicago, Milwaukee & St. Paul to accept a position with the Standard Stoker Company, Inc., as works superintendent at Erie, Pa. Mr. Hopper has been in constant railway service since 1893. He served his apprenticeship as machinist at the old W. T. Garratt Machine Company, San Francisco, Cal., and from 1889 to 1890 was in the marine service of the Pacific Mail Steamship Company. He then went to China as a mechanic. Later he became a mechanic and locomotive foreman on the Guatemala Central. He then entered the service of the Edison Light Company, Napa City, Cal., as an electrician and chief engineer. From 1893 to 1897, he served as a fireman on the Southern Pacific, when he was promoted to locomotive engineer. Resigning this position, he entered the employ of the Chicago, Rock Island & Pacific as road foreman of equipment. In 1911 he was promoted to master mechanic; in 1913 resigned to accept a position as master mechanic on the D. W. & P. Railway, which is controlled and owned by the Canadian Northern, and in 1919 entered the employ of the Chicago, Milwaukee & St. Paul.

S. T. Callaway, of the firm of Callaway, Fish & Co., New York, and his associates have acquired a substantial interest in and are financing the Elvin Mechanical Stoker Company, and Mr. Callaway has been elected president of the company. A. G. Elvin, the inventor of the Elvin mechanical stoker, who is largely interested in the company, has been elected vice-president and treasurer. Mr. Elvin is also the inventor of the Elvin driving box lubricator, the Franklin grate shaker and the Franklin fire door, and other successful economy producing devices in the steam locomotive specialty field. S. T. Whitaker, of the law firm of Hardy, Stancliffe & Whitaker, attorneys for the company, has been elected secretary. The directorate of the company includes the officers as mentioned above, and E. M. Richardson, of the Sherwin-Williams Company. A long term contract has been entered into with the American Locomotive Company, under which the stoker will be manufactured for this company by the American Locomotive Company, at its Schenectady works, thereby enabling the company to accept immediately contracts in quantity for stokers.

Hugh Pattison has joined the staff of the heavy traction railway department of the Westinghouse Electric & Manufacturing Company to make special engineering studies under the direction of F. H. Shepard, director of heavy traction. Mr. Pattison was graduated from the Johns Hopkins University, electrical engineering course, in 1892. His first position was that of foreman electrician of the Norfolk, Va., Navy Yards, wiring and installing electric apparatus on naval vessels. In 1893 he became assistant engineer with Sprague, Duncan & Hutchinson, consulting engineers at Baltimore. From 1894 to 1903 he was associated as engineering assistant to Frank J. Sprague, vice-president and technical director of the Sprague Electric Company in New York and assisted in equipping and operating multiple unit control on the Boston Elevated and in Brooklyn. In 1905 Mr. Pattison joined Westinghouse, Church, Kerr & Company as an engineer. From 1905 to 1911, during the electrification of the Pennsylvania tunnel into New York, Mr. Pattison was assistant engineer of electric traction for George Gibbs, consulting engineer. Later Mr. Pattison had charge of the electrification of the West Jersey & Seashore Railroad from Camden to Atlantic City. He also built an experimental single-phase electric railway on the Long Island Railroad and had charge of the conduct of locomotive tests on the West Jersey & Seashore Railroad to determine the effect on track. In 1911 he was appointed engineer in charge of the Chicago Association of Commerce Committee in the study of smoke abatement and the electrification of terminal railways in Chicago. During the war Mr. Pattison was appointed assistant to general manager of the Remington Arms Company.

The Precision & Thread Grinder Manufacturing Company, manufacturers of the multi-graduated precision grinder, have moved their offices to 1 South Twenty-first street, Philadelphia, Pa. At this new location they will maintain a machinery display department, showing in addition to their grinders, the Craley master tool maker, Miller radius and angle wheel dressers for tool room and production work, the Herrmann snap thread gages, and other tools and accessories.

TRADE PUBLICATIONS

LOCOMOTIVES.—The general dimensions and illustrations of various types of eight-coupled locomotives for freight service and locomotives for heavy passenger service are given in two illustrated books, Records No. 98 and 99, issued by the Baldwin Locomotive Works, Philadelphia, Pa.

AJAX METAL PRODUCTS.—A new 38-page, illustrated export catalogue has been issued in two editions—one English, and one Spanish—by the Ajax Metal Company, Philadelphia. This book is mainly devoted to a complete listing of Ajax products, with a detailed account of their uses in the various industries.

FOUNDRY EQUIPMENT.—In Bulletin No. 154, issued by the Whiting Foundry Equipment Company, Harvey, Ill., are described and illustrated complete layouts and equipment for gray iron, steel, brass, car wheel and malleable iron foundries. The bulletin contains a large number of illustrations taken in Whiting equipped plants.

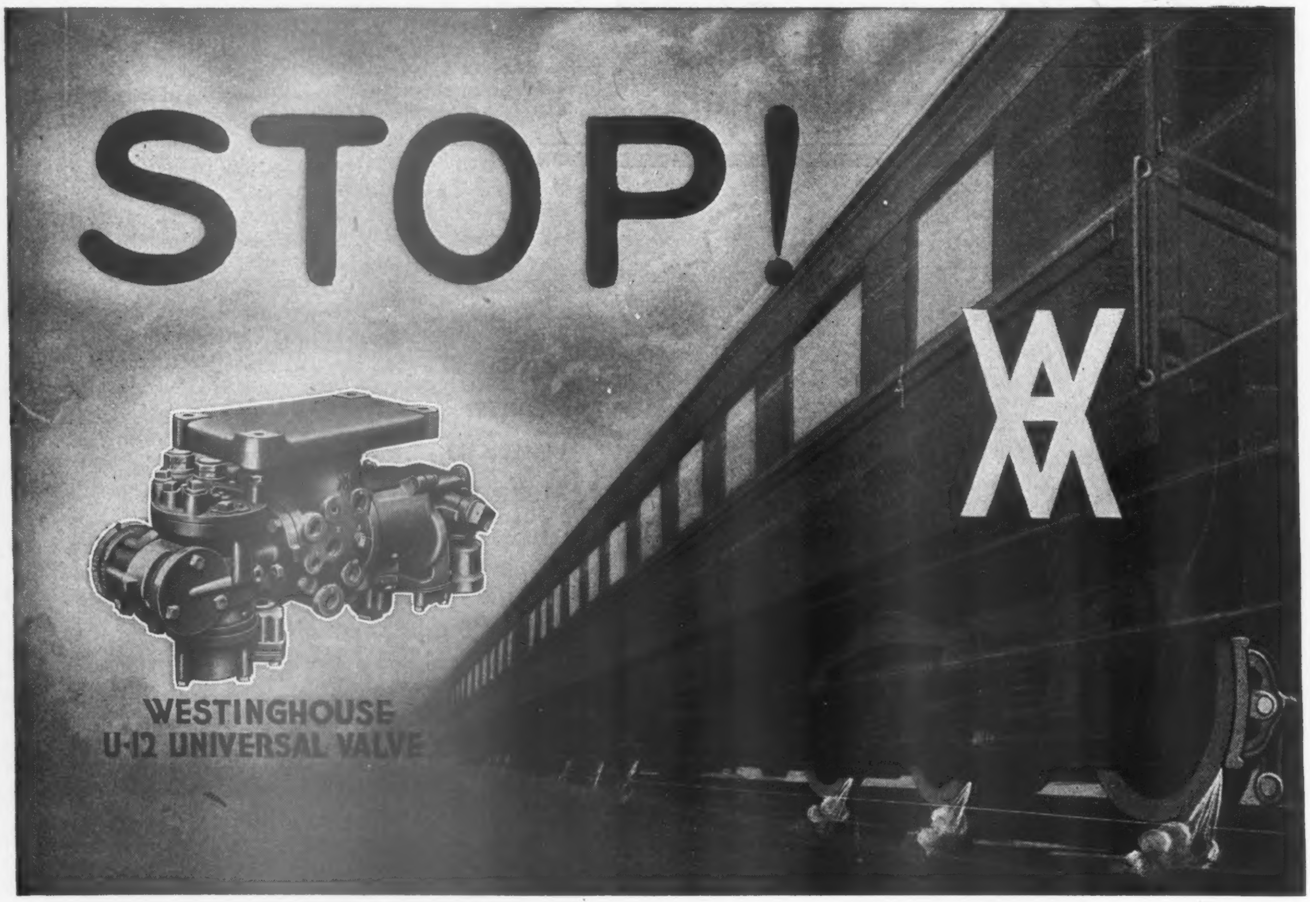
WOOD PRESERVATION.—Two folders recently issued by the Barrett Company give information regarding the preservation of timber by the use of refined creosote. One entitled "Preserving Wood Roof Decks with Carbosota" describes the surface treatments recommended for lumber used in roof construction. The second, entitled "Longer Life for Mine Timbers," discusses the selection and treatment of timber, not only for mine bracing but also for cars and buildings subject to decay.

MALLEABLE CASTINGS.—The American Malleable Castings Association has published a chart which is designed to show the present status of the malleable iron industry. The chart gives a graphical representation of the castings shipped by the member firms as compared with the capacity of the foundries. The association points out that it is expected that the tonnage of unfilled orders will be reduced in the near future and better deliveries will be made than have been possible since 1915.

PORTABLE ELECTRIC DRILLS.—The complete line of electric air compressors, portable electric drills and electric valve grinders made by the Black & Decker Manufacturing Company, Baltimore, Md., is described in Catalogue No. 2, recently issued by this company. The booklet includes descriptions of compressors of various capacities, electric drills for drilling holes up to 7/8 in. and reaming up to 7/16 in. in steel. The mechanical and electrical features of the equipment are quite fully described and the construction is shown by sectional views.

FIRE BRICK BOND.—"Hytempite in the Gas Plant" is the title of a bulletin issued recently by the Quigley Furnace Specialties Company, New York. According to the bulletin, Hytempite is a highly refractory plastic material, scientifically compounded, for bonding fire bricks and for kindred uses. The importance of this bond in the construction and maintenance of gas producers is particularly emphasized in the bulletin, but it can be used in railway shop or other industrial furnaces and boiler settings. Illustrations of this fire brick bond in emergency repairs are shown.

PIPE VALVES, FITTINGS AND TOOLS.—An attractive and unusual catalogue is the book recently published by the Walworth Manufacturing Company, Boston, Mass., for its export business. The extensive line of fittings, valves, boiler and engine accessories, and tools which this company produces is illustrated, descriptions being given in English, French, Spanish and Portuguese. Valuable engineering information is included such as the amount of expansion cared for by bends in wrought iron or steel pipe and conversion tables for English, metric and Latin units, etc. A comprehensive index in each of the four languages facilitates locating the equipment listed.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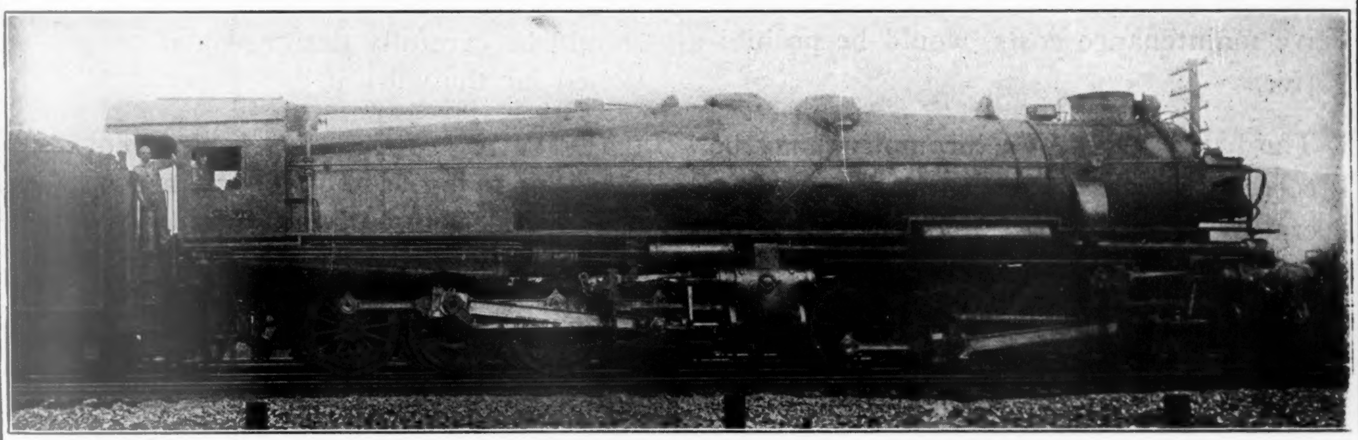

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